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MEASUREMENTS FOR INTRA-ORAL BLOCK OF THE MAXILLARY NERVE

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IN OPERATIONS on the mandible, nerve block is universally accepted as the method of choice for effecting local anesthesia. However, in maxillary operations there is less certainty as to the preferable procedure. Many workers use infiltration only; others combine infiltration with infra-orbital and tuberosity block. Relatively few operators attempt to block the maxillary nerve by the intra-oral route, although, when successfully carried out, the procedure affects the entire region supplied by Meckel's ganglion and the infra-orbital nerve and its branches.

There are numerous references in the dental literature describing the various procedures to be used in this form of nerve block by the intra-oral route. Smith[1] published his technic in 1920. The mucous membrane is entered in the buccal fold opposite the upper third molar tooth. He wrote:

> After puncturing the tissue in the manner described, the needle is advanced upward, inward, and slightly backward into the mucous membrane, allowing the bevel of the needle to reach the periosteum covering the lateral surface of the tuberosity at the approximate depth of 15 mm. After the needle reaches the periosteum at this depth, the needle is advanced in close contact with the periosteum, covering the posterolateral surface of the tuberosity, approximately 15 mm., making a total depth of 30 mm. The blocking of this large nerve trunk is easily accomplished; in fact, it is no more difficult than the inferior dental, lingual or some of the other intra-oral block injections.

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1. Smith, A. E., *Block Anesthesia and Allied Subjects*. St. Louis: C. V. Mosby Company, 1920, p. 383.

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Fig. 1.—Extremes of skull size

Gaston Labat[2] described two methods:

1. With a retractor or the forefinger of the left hand placed at the angle of the mouth, the cheek is well retracted upward and backward, and the needle inserted in the mucous reflection above the first upper molar tooth. The needle is then advanced in a direction backward,

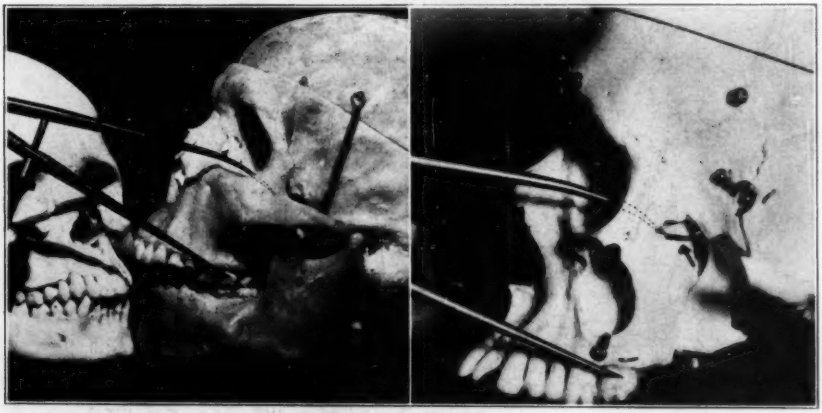

Fig. 2.—Left: Skull measurement from inferior orbital fissure to dento-enamel junction of second molar (needle distance). Right: Zygomatic ridge removed to show point of caliper in floor of inferior orbital fissure and thread (arrow) indicating course of maxillary nerve

2. Labat, Gaston, *Regional Anesthesia: Its Technic and Clinical Application*. Philadelphia: W. B. Saunders Company, 1923, p. 78.

upward, and inward, tangent to the tuberosity of the maxilla and making with the sagittal plane of the head an angle of about 40 degrees. The point of the needle loses contact with the bony surface at a distance of from 3 to 4 cm. from its point of entrance. It is then introduced 0.5 cm. further, and injection of 2 cc. of the 2 per cent solution made slowly.

2. With a needle bent to an angle of 145 degrees or with a straight needle connected with the syringe by a curved adjustment, the maxillary nerve may be blocked by introducing the needle behind the last upper molar tooth and directing it upward and a little inward, almost perpendicularly to the triturating surface of the teeth. The needle passes laterally in the angle formed by the tuberosity of the maxilla and the pterygoid process and at a depth of from 3.5 to 4 cm. reaches the sphenomaxillary fossa where 2 cc. of the 2 per cent solution is injected slowly.

A. M. Dogliotti[3] stated:

The Palatine Route. After submucosal local anesthesia by infiltration in the region corresponding to the posterior palatine foramen, at a distance of 1 cm. medially to the second molar, a needle is introduced into the foramen. This needle should be about 4 cm. in length and should be mounted at right angles to the syringe. The needle should be introduced directly upward in the sagittal plane and should run into the palatine canal at a depth of about 4 cm. The ganglion is injected with 2 cc. of the anesthetic solution.

Lundy[4] described the following technics:

The needle is inserted at the highest point in the mucous fold opposite the upper third molar tooth and sufficiently far laterally that the needle will not engage immediately the posterior surface of the tuberosity. The needle should now be advanced upward, medially, and slightly posteriorly with a view to reaching the infratemporal surface of the maxilla when the depth of penetration is approximately 2 cm. Care should be taken not to advance the

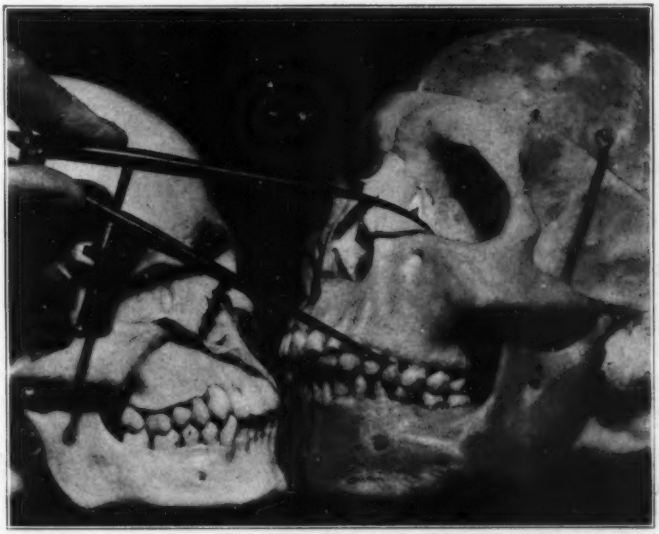

Fig. 3.—Skull measurement from infra-orbital margin to dento-enamel junction of second bicuspid (facial measurement)

3. Dogliotti, A. M., *Anesthesia: Narcosis, Local, Regional, Spinal.* Chicago: S. B. Debour, 1939, p. 424.
4. Lundy, J. S., *Clinical Anesthesia.* Philadelphia: W. B. Saunders Company, 1942, p. 185.

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Table 1.—Distribution of the difference between facial measurement and needle distance in 149 skulls with teeth in normal occlusion

Difference FM—ND	Frequency
—3*	2
—2	2
—1	5
0	26
1	43
2	35
3	38
4	8
6	1

Mean—1.42
Standard deviation—1.43

*A negative value means that the needle distance is greater than the facial measurement. A positive value indicates a greater facial measurement.

needle too far posteriorly. When bone of the anterior boundaries of the pterygopalatine fossa is touched, the needle is known to be in correct position. The needle is now advanced along the surface of the periosteum until it reaches a total depth of 3 cm., where from 2 to 3 cc. of solution is injected. The needle is inserted at a point midway between the margin of the palatal gum and the median line, and opposite the second molar tooth, where a few drops of solution are injected. If the foramen is not encountered on the first puncture, the needle is inserted again a few millimeters directly posteriorly. This can now be done without pain. When the canal has been found, the needle is advanced carefully upward and backward to a depth of about 3 cm. If a needle 25 gage 1⅝ inch (approximately 4 cm.) in length is used, about 1 cm.

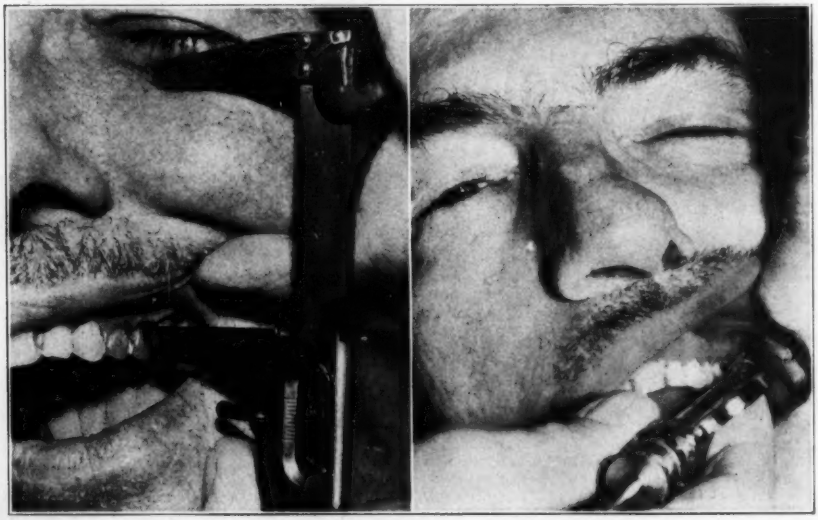

Fig. 4.—Left: Patient A. Facial measurement with caliper is 56 mm. Right: Needle inserted according to measurement, showing rubber stop

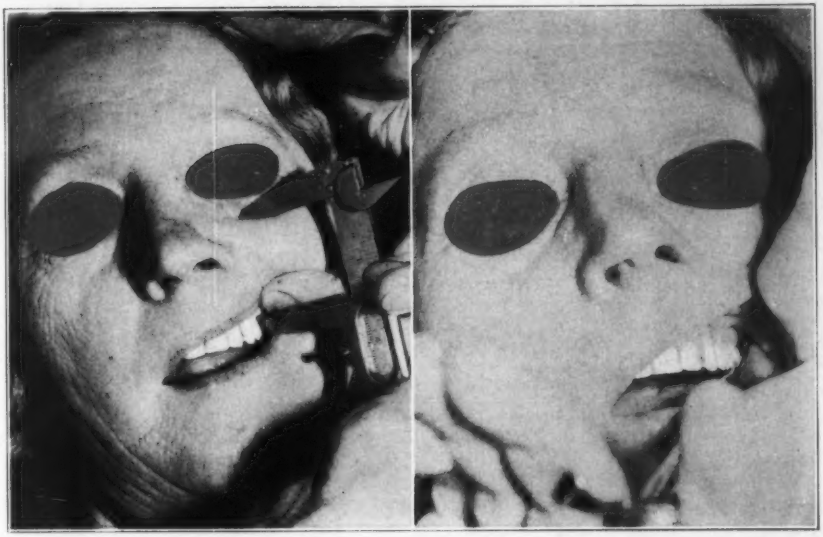

Fig. 5.—Left: Patient B. Facial measurement with caliper is 35 mm. Right: Needle inserted according to measurement, showing rubber stop

of the needle will project outside the tissue. Two cubic centimeters of solution is injected; the solution will diffuse in advance of the end of the needle and will reach a region considerably beyond it.

Despite these and other references to precise methods for effecting maxillary nerve block, the procedure has fallen into disfavor and is used very rarely at the present time. It is my impression that the main objection to it stems from the inability of the operator to determine the depth of injection essential for optimum anesthesia. Most

Fig. 6.—Left: Patient C. Facial measurement with caliper is 42 mm. Apparently facial length does not necessarily indicate relative bony measurements. For example, patients B and C have a difference of 7 mm. in the facial measurement but exactly the same facial distance from the external canthus of the eye to a horizontal line extended from corner of mouth. Center: Needle injected according to measurement, showing rubber stop. Right: Injection given through posterior palatine foramen, showing same measurement as for previous injection

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authors refer to an average distance of injection, but in practice this has proved to be of no value. My associates and I determined to study experimentally the anatomic distances involved in order to arrive at a more precise understanding of the problem.

Experimental Studies

Dr. Spencer R. Atkinson, of the University of Southern California, kindly made available to us his extensive collection of human skulls (Fig. 1). After measurement of 200 adult skulls, 149 with teeth in normal occlusion and the remainder in malocclusion, it was found that the distance from the inferior orbital fissure to the dento-enamel junction of the second molar, hereafter referred to as the "needle distance," varied from 29 to 51 mm. (Fig. 2). If it is now considered that the distance from the gingival margin to the buccal fold may vary from 3 to 12 mm., one realizes the problem inherent in using a fixed depth of injection, whether it be 2, 2.5,

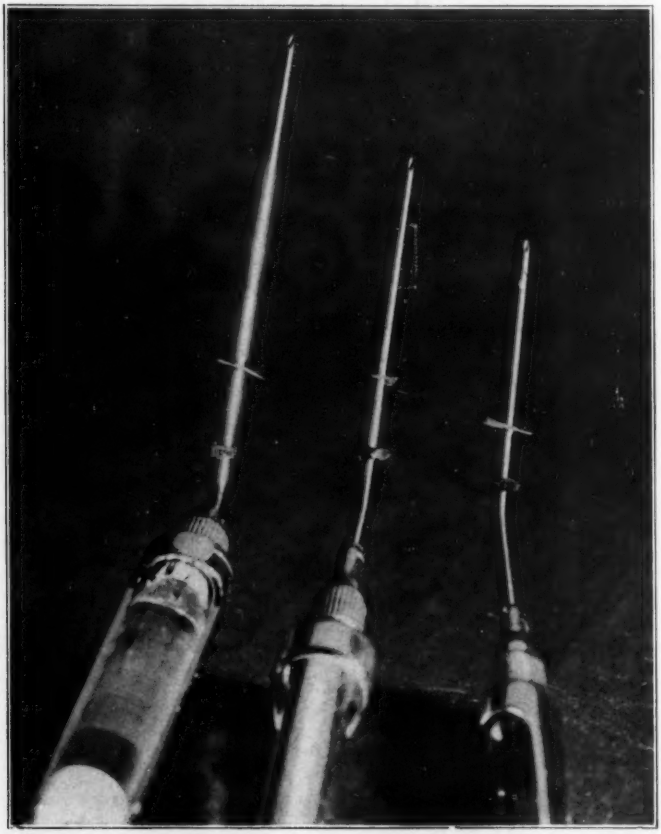

Fig. 7.—Relative needle distance for patients A, C and B, showing extra rubber stops and needle penetration from buccal fold

Table 2.—Measurements of 43 skulls with teeth in malocclusion

Skull	Class	Needle Distance	Facial Measurement	Difference FM—ND
63	I	31	32	—1
55	I	33	36	—3
216	I	33	36	—3
242	I	35	38	—3
93	I	38	40	—2
92	I	38	37	—1
102	I	39	41	—2
204	I	39	39	0
243	I	40	42	—2
31	I	40	42	—2
100	I	41	41	0
101	I	42	44	—2
5	I	43	44	—1
69	II	27	30	—3
78	II	32	34	—2
80	II	34	35	—1
59	II	35	38	—3
58	II	36	38	—2
33	II	40	45	—5
229	II	41	42	—1
217	II	42	42	0
218	II	44	46	—2
96	II	45	48	—3
4	II	48	49	—1
238	III	35	36	—1
181	III	37	39	—2
87	III	38	37	—1
190	III	38	40	—2
174	III	38	40	—2
214	III	41	42	—1
226	III	42	40	—2
227	III	43	43	0
203	III	44	45	—1
202	III	48	47	—1
172	Open	34	36	—2
30	Bite	37	46	—9
29	"	38	46	—8
28	"	39	46	—7
177	"	40	41	—1
169	"	41	43	—2
168	"	42	45	—3
193	"	42	49	—7
199	"	42	42	0

or 4 cm. as suggested before. The two variable distances, the height of the buccal fold and the needle distance, negate the value of any fixed depth of injection.

In the course of our study on these skulls we found a close relation between the distances from the inferior orbital fissure to the dento-enamel junction of the second molar (needle distance) and the distance from the infra-orbital margin to the dento-enamel junction of the bicuspids (Fig. 3), hereafter referred to as the "facial measurement" (Table 1).

Observation of the data revealed that (1) the facial measurements range from 6 mm. longer to 4 mm. shorter than the needle distance; (2) the facial measurement is greater in 140 cases and less in 9 cases; (3) the mean difference between the two measurements is —1.42 mm. with a standard deviation of —1.43; (4) by subtracting 1.5 mm. from the facial measurement it is possible to approximate the average needle-distance, and (5) a range of —2 mm. from this value will include 84 per cent of all cases.

If the range is extended to —3 mm., 96 per cent of all persons will be included.

Clinically, it is possible to measure the facial distance with a caliper, applying one point to the infra-orbital margin and the other to the gingival margin of the second bicuspid. The distance then is marked off on the 20 gage bent hypodermic needle with a movable rubber stop, and the insertion is made until this is opposite the gingival margin of the second molar (Figs. 4 and 5).

Using this method on a large number of patients, we have obtained excellent results. One patient with a measurement of 29 mm. showed excellent results, as did also several adults with a measurement (on the other extreme) of from 46 to 56 mm. (Fig. 6).

These data have been derived from studies of skulls with teeth in normal occlusion (Fig. 7). The results obtained on skulls with teeth in malocclusion are listed in Table 2.

The various types of malocclusion seem to support the same rules given for skulls with teeth in normal occlusion, except for some of the skulls with teeth in open-bite malocclusion.

Summary

A method is described for maxillary nerve block. The extra-oral measurement of the distance from the infra-orbital margin to the gingival margin of the second bicuspid is a good index of the desired depth of injection (Fig. 7).—*312 North Boyle Avenue.*

THE SURGEON AND HIS TRUST

The background of training of the surgeon should be broad. But having acquired orientation and competence, a surgeon must of necessity, if he aspires to rise above mediocrity, give selective direction to his activity instead of trying to grow in all directions simultaneously. The public has the right to demand a high standard of performance from us. Moreover, we are all debtors to our profession and from those of us who have enjoyed opportunities above the ordinary, society reasonably may expect that we should strive to add something to the sum total of knowledge rather than continue to be parasites upon our common heritage.—Owen H. Wangensteen, in *Surg., Gynec. & Obst.* **84**:567 (April 15) 1947.

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PRESENT STATUS OF ARTHROSIS OF THE TEMPOROMANDIBULAR JOINT

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IN GENERAL, joints consist of two or more bones in contact with each other at the articular ends, which are usually broadened for the purpose and adapted in shape to move on each other. The articular ends of the bones are covered with white hyaline cartilage having a smooth glistening surface, and the bones are held in contact by ligaments and muscles as well as by atmospheric pressure. Bones entering into the formation of a joint are surrounded and connected by a collar, constituting the capsule on the outside, continuous with which and extending to the inside of the joint is a layer of synovial membrane. The principal function of the synovial membrane is to secrete a lubricating fluid for the joint. This fluid, or synovia, is clear, light yellow and viscid to the touch, looking and feeling much like the white of an egg. Its chemical composition, especially with reference to sugar determination, is quite analogous to that of spinal fluid. This determination is of value from a diagnostic standpoint, as it is not a difficult nor a contraindicated procedure to aspirate synovial fluid from the joint in suspected synovitis. The secretion of synovia is stimulated by motion of the joint and decreased during rest. Normal joints contain varying amounts of synovia at all times for purposes of lubrication, and attempts to substitute lubricating material such as vaseline and oils in joints having an abnormally small amount of this fluid are unsuccessful because of the resorptive powers of the synovial membrane.

Normal Anatomy of the Temporomandibular Joint

If one reviews several texts on the structure and function of the temporomandibular joint, it will be found that the descriptions of the joint by different authors vary in several respects. These divergent views regarding the structure and function of the joint are doubtless the result of variations in the dissection material.

The temporomandibular joint belongs to the class of true articulations with cartilage covered joint surfaces, synovial membrane and joint space and to the class of compound joints because of the inserted meniscus which divides the joint into two cavities, an upper and a lower articular cavity. The articular surfaces are located partly on the temporal bone, partly on the mandibular condyle and partly on the meniscus. The joint surface on the temporal bone consists of a posterior concave section, the glenoid fossa, and an anterior convex portion, the eminentia articularis. Only the anterior portion of the glenoid fossa is covered with fibrocartilage, namely, the part lying on and adjacent to the articular tubercle and against which the condyle, together with the interposed meniscus, normally rests and moves. The eminentia articularis is covered with fibrocartilage.

The mandibular condyle is a thick bony cylinder placed across the upper end of the neck of the mandible; its longitudinal axis is identical with that of the glenoid

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fossa. Anteriorly the delimitation of the joint surface is very sharp, while posteriorly the transition to the neck of the mandible is gradual, being marked merely by a slight rough crest. Only the anterior part of the condyle is covered with fibrocartilage, namely, the part which actually articulates with the anterior part of the glenoid fossa and with the posterior and inferior aspects of the eminentia articularis.

The meniscus, or intra-articular disk, is an oval biconcave structure of dense fibrous connective tissue interspersed with a few cartilaginous cells transversely placed. In the middle it is thin, while anteriorly and posteriorly it is considerably thicker. When the teeth are in centric occlusion the anterior margin of the disk lies under the articular tubercle, and the posterior edge fills the interval betwen the condyle and the glenoid fossa. The meniscus divides the joint cavity into two completely separate spaces, an upper meniscotemporal and a lower meniscocondylar, which are said normally to communicate only in exceedingly rare cases through a perforation in the disk.

The capsule, which generally is lax, so lax in fact that as a rule it does not tear even on dislocation of the condyle, forms a thin band of connective tissue from the margin of the upper joint surface to the neck of the mandible, to which it is attached farther down posteriorly than anteriorly. The capsule is fused with the disk in its entire circumference. The external pterygoid muscle inserts into the anterior part of the joint capsule at the disk level. This fact has caused many investigators to think that the disk is a tendon plate for the muscle.

Mandibular Movements

The temporomandibular joint may be designated as a free joint, as within rather wide limits any point on the lower jaw may be moved freely in all three directions. The individual components of the movements in the temporomandibular joint in speech and mastication are rather difficult to analyze. In the main, the components are (1) the hinge movement in the lower joint cavity, between the meniscus and the condyle, by which the mandible is lowered or raised on opening or closing of the mouth; (2) protrusion and also, in a slight degree, retraction of the mandible, which movement chiefly takes place in the upper joint cavity between the meniscus and the glenoid fossa, together with the articular tubercle, and (3) rotary movements. In repose, the lower jaw is slightly open with an interval of 2 or 3 mm. between the occlusal and incisal surfaces of the teeth. The mandible, therefore, hangs in ligaments and muscles.

When the teeth are in occlusion the condyle rests against the thin part of the meniscus at the posterior aspect of the eminentia articularis. When the mouth is opened the mandibular movements proceed as follows: The anterior part of the mandible is lowered by turning of the condyles, which movement takes place in the lower joint cavity. At the same time the meniscus and the condyle slide forward and downward to the inferior aspect of the tubercle, sometimes even beyond its anterior border. This last movement takes place in the upper joint cavity. The forward movement of the meniscus is made possible by the insertion of the external pterygoid muscle in the capsule and thus in the meniscus. In this way the meniscus constitutes a wandering joint surface for the condyle, and during its movement it undergoes certain changes in form corresponding to the varying parts of the osseous joint surfaces with which it comes in contact. The disk, therefore, by virtue of its position, flexibility and mobility, assists in the articulation between the condyle and the tubercle. But for it, the condyle and tubercle would merely articulate with one another. The disk, in fact, serves to adjust incongruities between the two articular surfaces. Owing

to its elasticity it can adapt itself to the surfaces of both the condyle and the tubercle. The importance of the disk as a shock absorber has been pointed out by many authors. The pressure of mastication is first received by the suspension apparatus of the teeth and secondly by the disk. During forcible biting the condyle causes compression of the disk. This compressibility and elasticity would thus seem to make a full masticating effect possible.

Nomenclature

Disease conditions of noninflammatory nature of the temporomandibular joint, characterized by disturbances in its function, have been described under different names. The multiplicity of names is mute testimony to the lack of a comprehensive understanding of the disease conditions. For the most part these names have been coined after the more prominent symptoms such as cracking and snapping jaw and habitual dislocation; or according to the supposed changes in the joint such as diskitis, dislocation of the disk, luxation or subluxation. Also they have been described under headings applicable to articular changes of more indefinite nature: arthrosis, subarthrosis, dysarthrosis and the disk mandibular syndrome. It would be unscientific and undesirable to attach a name to this affection that would have as its basis a single particular symptom or a supposed but unproved articular change. Accordingly, the term "temporomandibular joint arthrosis," as suggested by Boman,[1] would seem to designate the condition properly, especially since the changes are of the arthritis deformans type.

Pathogenesis

This disease entity was reported by Cooper[2] as early as 1842. The author drew attention to a disease condition in the temporomandibular joint characterized by snappings in the vicinity of the ear, which he considered to be caused by a slackness in the capsule of the joint. The author pointed out that the complaint was most common in young women. The entity has subsequently been described in a large number of published reports, various methods of treatment have been launched and many theories regarding its pathogenesis have been advanced.

History of the Disease

In 1887, Annandale[3] reported two cases of this nature. He considered that the disk had been dislocated by a sudden rupture of the attachment or by gradual yielding, and introduced surgical treatment based on the same principles as he adopted in lesions of the knee joint meniscus. He opened and exposed the joint, after which the disk was repositioned and sutured with catgut to the outer side of the joint. The result of this treatment, however, is not indicated.

Disk extirpation as a method of treatment was introduced by Lanz,[4] in 1909. He operated on two young women with a foreign body sensation and snapping in the temporomandibular joints. The abnormally mobile disk, which, when the mouth was opened wide, moved far forward with a snapping sound, was extirpated. The operations had favorable outcomes.

1. Boman, Karl, Temporomandibular Joint Arthrosis and its Treatment by Extirpation of the Disk. *Acta chir. Scandinav.* (supplement 118) 95:1, 1947.

2. Cooper, Sir Astley P., *A Treatise on Dislocations and on Fractures of the Joints.* London: J. Churchill, 1842.

3. Annandale, T., On Displacement of the Interarticular Cartilage of the Lower Jaw and Its Treatment by Operation. *Lancet* 1:411, 1887.

4. Lanz, A. B., Discitis Mandibularis. *Zentralbl. f. Chir.* 36:289, 1909.

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During the late twenties and early thirties a number of authors, including Costen,[5] stressed the part played by bite anomalies in the origin of disturbances of the temporomandibular joint.

Symptomatology

Temporomandibular joint arthrosis presents a rather classical set of clinical symptoms. The acute symptoms are usually preceded by a history of a snapping sound in the joint. This snapping may occur intermittently or at the termination of the opening movement and is directly related to the meniscus. It indicates joint derangement in all instances, but in many cases acute symptoms do not develop. Terminal snapping occurs in joints having hypermobility and excessive excursion. Both intermediate and terminal snapping may occur during the same opening movement. It is highly unusual during the closing movement. In all cases of snapping or noisy joints the meniscus is at fault, as extirpation of this structure effects immediate cessation of the symptom.

In many cases the symptoms are limited to the audible snapping; in others, local symptoms of more or less profound nature develop. These cases are characterized by palpable tenderness, pain and restriction of motion. It is well known, however, that these acute symptoms may disappear completely for a considerable length of time or for good. It is characteristic that after prolonged inactivity of the joint, as after a night's sleep, the patient finds it difficult to yawn, the jaw feels rusty and has to be exercised for a considerable length of time before function becomes normal. In the majority of cases the articular disturbances are unilateral and, for some reason, are much more common in women than in men.

In addition to these local symptoms a number of other symptoms that seem to be reflex in nature usually occur. Among these may be enumerated pain within and about the ears, often radiating forward to the malar area and down the neck; tinnitus, usually low-buzz in type, and stuffy sensation in the ears. A number of other suspected symptoms have been described by various authors, such as mild catarrhal deafness, dizzy spells, typical sinus headaches, a burning or prickling sensation of the tongue and throat and eczema within the external ear. I am quite impressed with the absence of these last-mentioned symptoms in the cases I have observed.

Diagnosis

The diagnosis of temporomandibular joint arthrosis is easy when one of the local symptoms is prominent. Frequently the patient finds it difficult to locate the snapping which may also be difficult to determine by palpation. In this connection a stethoscope is valuable. It is desirable to palpate the two joints simultaneously from outside or with the palpating fingers placed in the outer auditory canals. Crepitations, snappings and differences in the movements of the two condyles can, as a rule, be easily ascertained. Tenderness of the joints is also demonstrated.

In making the diagnosis, arthritis and inflammatory processes in the vicinity of the temporomandibular joint, which may cause similar symptoms, should be ruled out.

From reports of operations in described cases, von Stapelmohr,[6] in 1929, en-

5. Costen, J. B., Syndrome of Ear and Sinus Symptoms Dependent Upon Disturbed Function of the Temporomandibular Joint. *Ann. Otol., Rhin. & Laryng.* 43:1 (March) 1934.

6. von Stapelmohr, S., Sur les craquements de l'articulation temporomaxillaire et les luxations habituelles de la mâchoire. *Acta chir. Scandinav.* 63:1, 1929.

deavored to ascertain to what changes in the joint the different symptoms could be attributed. He was unable, however, to find any changes in the form, position or mobility of the disk that could be regarded as characteristic of the special symptoms.

Many investigators are in general agreement that the fundamental cause is to be found in a lowered bite and is precipitated by a retrusion of the condyle owing to this particular change of the bite. A restoration of the normal bite would consequently be the proper treatment. The results of such treatment are stated by adherents of the closed bite theory to be so striking that they bear out the correctness of the theory. The precise way in which the different symptoms are precipitated by the retruded condyle has not, however, been made clear. It is considered that there are many different ways in which a disturbance in the function of the temporomandibular joint might give rise to symptoms. Among the theories of these causes are (1) direct pressure of the condyle on the external auditory meatus, (2) blocking of the eustachian tube by lowering of the bite and retrusion of the lower jaw, and (3) pressure of the condyle on adjacent blood vessels and nerves.

Like other joints in the body the temporomandibular joint can sustain injuries through incorrect or one-sided stress with resultant transformation of the articular surfaces. The unilateral loss of teeth with one-sided chewing invariably produces a working side and a balancing side. The strain caused by this one-sided manner of mastication is capable of causing joint derangements that are chiefly characterized by a planing off of the articular eminence. Mastication is performed by congruent movements, and any malocclusion preventing an inclusive use of the bite has a detrimental effect on the joint. Normal occlusion is a rarity and that is why, in anatomic examinations, the articular surfaces, from patient to patient, display such wide variations.

Roentgenography

Owing to the location of the joint immediately under the base of the skull, it is exceedingly difficult and often impossible to obtain a free presentation of the various parts of the joint in the roentgenogram, and the information gained from such an examination is often poor, either completely negative or, at any rate, most unreliable. Thus, in spite of pronounced symptoms, the findings presented by an ordinary roentgenogram are not infrequently to be designated as quite normal or, at the most, as minor deviation from the normal. In 1938 laminagraphy was emphasized as of value in visualizing the joint, and more recently, in 1944, arthrography has been claimed valuable in the understanding of the genesis of various temporomandibular joint syndromes. I have had no experience with this method of investigation of symptomatic cases. If it were possible adequately to visualize the joint in a normal roentgenogram the following details should be taken into consideration: (1) the general form of the condyle, its convexity, marginal spines, and detached calcific bodies or joint mice; (2) the direction of the collum, if straight or inclined forward or backward; (3) open or closed form of the joint; (4) the inclination of the tubercle and its convexity; (5) the size of the joint space, and (6) the position of the condyle in the joint.

Normal roentgenography falls far short of meeting these requirements and of demonstrating the presence of changes which can be taken with any degree of certainty to signify the most frequent lesion of the joint, temporomandibular arthrosis. Usually such roentgenograms will show only changes in the position of the condyle and the extent of its mobility, provided films are made in both the open

and closed position. Frequently, in clinically unquestionable cases of arthrosis, the roentgenographic findings have to be designated as normal. This is because the cartilaginous part of the joint may be the site of even considerable changes without giving rise to changes demonstrable in the ordinary roentgenogram.

Of the special roentgenographic technics that have been attempted to visualize the temporomandibular joint more clearly, arthrography would seem to have the greatest possibility. This technic employs the injection of a radiopaque contrasting medium into a single joint space at a time, after which roentgenograms are made of the joint in both the open and closed position. The contrast medium is an aqueous, iodine-containing solution known as Perabrodil 35 per cent. Norgaard,[7] of Copenhagen, contributed a monograph on the subject recently. He claimed that the injection is attended with little pain and only slight inconvenience to the patient, and that the contrast medium is quickly absorbed; after ten to fifteen minutes, only a faint contrast shadow remains. In summary, Norgaard stated:

On the basis of our knowledge of the normal anatomy, structure as well as mobility, of the temporomandibular joint and of the present possibilities for roentgenography of the joint, both parts being reviewed briefly, a technique was then worked out for contrast filling of the temporomandibular joint. The more important principles of this method are contrast filling and roentgenography of each joint cavity separately—as a rule, the lower cavity before the upper—with the least inconvenience to the patient and with the obtainment of roentgenograms as detailed and indisputable as possible.

Through its application in 113 cases this technique has proved very sure and reliable as soon as the examiner has had a little training in its employment, and the results have been reliable. This could be ascertained by correlation of the operative and the arthrographic findings in the 25 cases where an operation was performed after this examination.

The present studies show that in temporomandibular arthrosis, as was to be expected, ordinary roentgenography of the joint is of no dependable diagnostic value in a great majority of cases. Furthermore, there is no definite relation between the intensity and duration of the clinical symptoms and the character and degree of the pathological changes, nor between these and the character of the symptoms. In view of this, it is only reasonable to attach considerable significance to arthrography in the diagnosis of this lesion, especially as to the localization and estimation of the degree and character of the pathological changes and thus, most likely, to the choice of the treatment in the individual case. In this respect, it will be of particular importance if we are able, by means of arthrography, primarily to pick out the cases unsuitable for conservative treatment on account of the character and extension and localization of the changes. For then it will be possible in this way to spare such patients a protracted and extensive treatment. On the other hand, the present studies show that several cases may become symptom-free under conservative treatment, in spite of the presence of even considerable changes in the joint cavities—something that could not be demonstrated previously.

The inconvenience given the patients by this form of examination is to be looked upon as moderate in proportion to the significance of the examination to an estimation of the affection of the patients. Furthermore, this inconvenience may be kept within moderate limits by observing certain simple rules of caution in the performance of the examination, the most important of which is to avoid any excessive pressure in the joint, resulting in its distention.

Of contraindications for the performance of this examination, the only one appears to be any form of inflammatory process in and around the joint, while a very young age or a pronounced mental lability of the patient may be a reason to omit an otherwise well-indicated examination of this kind.

Treatment

Temporomandibular joint symptoms such as snapping, crepitations and disorders of movement, together with slight subjective complaints, are common. Se-

7. Norgaard, Flemming, *Temporomandibular Arthrography*. Copenhagen: Einar Munksgaarde, 1947.

verely distressing symptoms, on the other hand, are fairly rare, and they cannot always be alleviated by conservative treatment. It is also a well known fact that severe temporomandibular joint symptoms can disappear spontaneously after shorter or longer periods. Surgical treatment of arthrosis of the temporomandibular joint therefore is seldom resorted to. Neither the benign nature of the disease nor successful results of conservative forms of treatment may be considered as a reason for the infrequency of surgical treatment. Severely distressing temporomandibular joint symptoms, defying the prevailing forms of conservative treatment, may be present during considerable periods. The infrequency of surgical treatment seems to be a result of insufficient knowledge of the possibilities of such treatment. Many times patients are advised by their their physicians against operation.

The existing uncertainty as to the value of surgical treatment in relation to other forms of treatment suggested is not surprising. On the whole, the medical literature deals scantily with arthrosis of the temporomandibular joint and its treatment. It is chiefly the spokesman for those who employ conservative treatment, who have expressed their opinions and have described the extirpation of the disk, the most frequently performed operation, as being too extensive an interference with the joint, injurious to the joint as well as to the bite.

Generally speaking, the treatment of this anomaly, both conservative and surgical, is difficult to evaluate because so few cases have been reported in which the observation period has been sufficiently long to be of any value.

It has been stated that treatment with local application of heat sometimes has a relieving effect. Short wave diathermy would seem to possess more beneficial effect than the local application of a hot water bottle or electric heating pad. Such treatment, in conjunction with practicing of movements, may have a good effect on rusty joints and in mild cases of intermittent constriction. Roentgenotherapy has been used with mixed results. It is more than probable that the stage of development of the arthrosis is a determining factor in the response to roentgenographic treatment and other therapeutic measures. Again the need of a more detailed diagnosis is demonstrated. Salicylates in adequate doses have a long-standing and well-proved beneficial effect on certain joint diseases.

Immobilization has been tried in some cases, but again, no series of cases has been large enough for the formation of definite conclusions.

Goodfriend[8] was among the first, if not the first, to point out the connection between temporomandibular joint arthrosis and malocclusion. He recommended the restoration of normal intermaxillary relations, and this method of treatment has been rather generally adopted in the treatment of this disease. The results of this restoration of a natural bite are stated to be satisfactory unless the articular changes are marked or have existed too long. In cases of gross anatomic changes in the joint, one cannot, of course, expect any success with this method of treatment. It should be noted also that restoration of the bite is sometimes a lengthy and technically difficult procedure and that, owing to its extensiveness, is in many cases impracticable.

A form of treatment which has been practiced to a considerable extent is injection of the joint with sclerosing agents. This method is not without danger, and its usefulness, if any, would seem to be limited to that type of diseased joint having hypermobility. The injection treatment certainly is not indicated in ordinary intermediate snapping or constriction. In such cases there is no slackness of the capsule

8. Goodfriend, D. J., Dysarthrosis and Subarthrosis of the Mandibular Articulation. *D. Cosmos* 74:503 (June) 1932.

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that need be tightened, nor an opening movement that need be reduced.

In the surgical treatment the aim, broadly speaking, has been to remove extensively damaged disks or to limit the extent of the movement in the joint by plastic procedures.

Extirpation of the disk has been increasingly adopted and recommended by a number of authors. The availability of the disk for examination prior to its extirpation is such that there is little opportunity to decide on the advisability of the procedure before the disk has actually been removed. Disk exirpation is a violent intervention as far as the joint is concerned. The joint is deprived of its shock absorber and is suddenly converted from a finely differentiated compound joint—an upper gliding compartment and a lower rotary compartment—into a simple joint with articular surfaces deprived of the harmony furnished by the disk. The reaction of a joint to such a transforming operation needs considerable study and observation for proper assessment of the value of the procedure.

In order to prevent abnormal condylar excursions, attempts have been made to limit the movement of the joint by different plastic operations. These have consisted of a number of procedures, from shortening the capsule to producing additional obstacle at the eminentia articularis. For the most part these procedures would seem to fall in the category of being ill-founded and superfluous. In short, it would seem that there is no correlation between the symptoms of arthrosis of the temporomandibular joint and treatment.

Conclusion

In substance, the foregoing discussion presents the current status of arthrosis of the temporomandibular joint. It is readily seen that considerable study remains to be done before treatment of patients with this symptom complex ceases to be empirical.

Will it be possible, as is the case with other skeletal joints, to decide from an analysis of the symptoms whether a joint will react to conservative treatment? If so, what is the treatment of choice? What are the symptoms that will declare that the diseased joint would best be treated by operation? Is there a better surgical approach to a joint than the vertical incision anterior to the ear? Is arthrography the answer to better diagnosis of affections of the temporomandibular joint? Is the loss of molar support a contributing factor to the disease? We must recognize that arthrosis of the temporomandibular joint is present in a large number of patients in whom the molar and bicuspid occlusion is good and forms an effective support for the bite. On the other hand, many patients have passed through all possible stages of loss of teeth and have become completely edentulous without any trouble in the joints or objective symptoms on examination. What per cent of patients will be relieved of symptoms by removal of impediments to the glide of the mandible? Why does arthrosis of the temporomandibular joint occur more often in women than in men? Does any particular bite contribute to the incidence of the disease?

Answers to these and many other questions should be pursued in an investigation. I believe that it will be a difficult problem to study and one that cannot be concluded short of several years spent in critical evaluation of methods of treatment and long-standing results.—*Henry Ford Hospital.*

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ODONTOGENIC INFECTIONS OF THE JAWS: THEIR TREATMENT WITH ANTIBIOTICS

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Boston

INFECTION of odontogenic origin may cause many complications, such as sepsis of fractures compounded into the mouth, osteomyelitis, secondary neck infections and facial cellulitis. These conditions frequently represent an acute exacerbation with extension from a latent dental focus that has become active or aggravated by trauma, such as tooth extraction, or are precipitated by lowered resistance caused by fatigue or a debilitating general disease.

The advent of chemotherapy and especially the employment of antibiotics to prevent and combat bacterial disease has considerably altered the treatment of infections about the jaws. These new agents do not necessarily eliminate surgical interference, particularly not the removal of the cause, but they make it possible to institute earlier surgical measures with greater safety to the patient, so as to effect a more rapid convalescence. Thus, in most instances, the use of antibiotics combined with carefully planned and adequate surgical treatment gives the best results.

Treatment with Antibiotics

In consideration of therapeutic measures, the identification of the morbid organisms is almost as important as the finding of the immediate cause of the disease. A thorough bacteriologic study should be made in all cases because of the selective effect of the antibiotic drugs. If the infected tooth is still present, a culture may be made when it is extracted, although care must be taken to prevent contamination. If the patient has received penicillin previous to tooth extraction, clarase must be added to the culture mediums or there may be no growth. This reaction, of course, would simply indicate that the organisms are penicillin-sensitive. Both aerobic and anaerobic cultures are essential, and a smear should be examined for Vincent's organisms, because of the difficulty in growing the fusospirochetal organisms *in vitro*.

The bacteria found most commonly in infections of the jaw and neck are the alpha and beta hemolytic streptococci, the nonhemolytic streptococcus, and the Staphylococcus aureus and albus. Jaw infections are generally mixed infections with the following additional organisms: bacterioids, Bacillus perfringens, B. ramosus, B. coli, and other gram-negative bacilli and clostridia. Many of the latter are known to be penicillin-resistant but are affected by streptomycin. Sensitivity tests should be used to determine the specific treatment. These have been discussed by Hoffman.[1] The importance of determining the exact bacteriologic factors is illustrated by two cases which are recorded briefly.

Read before the Section on Hospital Dental Service at the eighty-eighth annual meeting of the American Dental Association, Boston, August 6, 1947.

Professor of oral surgery, Harvard University, and oral surgeon and chief of dental department, Massachusetts General Hospital, Boston.

1. Hoffman, W. S., Penicillin: Its Use and Possible Abuse. *J.A.D.A.* 34:89 (January) 1947.

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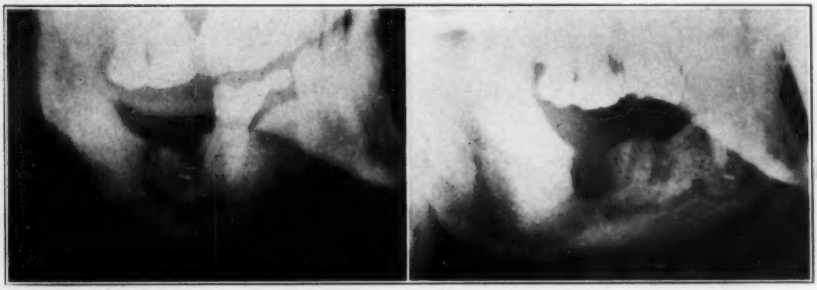

Fig. 1.—Left: Osteomyelitis of the mandible. Right: Roentgenogram of the mandible after extraction of tooth, sequestrectomy and saucerization

Case 1

The patient, a man, aged 54, had had chronic osteomyelitis of the mandible for one year. Two infected teeth had been extracted, and penicillin treatment was used, but a draining fistula remained. The roentgenogram showed osteomyelitis which caused intermittent swelling and suppuration (Fig. 1, left). Bacteriologic examination revealed a pure culture of Escherichia coli. The patient was treated with streptomycin, 0.2 gm. every four hours and penicillin, 24,000 units every three hours. Saucerization and sequestrectomy of the involved section of the mandible was performed (Fig. 1, right), followed by topical instillation of penicillin through a catheter to the bone cavity, and continuation of the intramuscular injections. The wound was completely healed two and a half weeks later.

Comment.—Because of the presence of penicillin-resistant organisms, previous treatment was unsuccessful until streptomycin was administered.

Case 2

A man, aged 43, had an extensive hard swelling of the right side of the face, which began after excision of an impacted third molar six months previously. He had been treated with poultices, penicillin and streptomycin, and x-ray irradiation. Multiple fistulas drained seropurulent discharge. Incision and drainage were performed on January 3.

Anaerobic cultures yielded Clostridium sporogenes; the smear showed an abundance of spirochetes and fusiform bacilli. There was no evidence of actinomycosis. The patient was given 48,000 units of penicillin every three hours, and streptomycin, 0.2 gm. every four hours, with slight improvement. Frequent irrigations of the fistula with an aqueous solution of chlorophyll were instituted on January 7 and continued until January 11, when the patient was discharged relieved. Three weeks later all fistulas had healed.

Comment.—In spite of treatment with both penicillin and streptomycin a mixed anaerobic infection of the face did not respond until chlorophyll raised the local tissue resistance to infection.

Extraction of Offending Tooth

Surgical procedures should be planned carefully. The right method must be applied at the right time. In odontogenic infections, removal of the causative tooth is of primary importance. In most instances the infection spreads through the pulp canal of a carious tooth or root. Periodontal infection and pericoronal infection of a partly erupted impacted tooth are also frequent etiologic factors. If the cause is not removed, recovery is delayed and complications may set in, as illustrated in the following case.

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Case 3

A woman, aged 31, had been treated for submental phlegmon by chemotherapy and incision and drainage.[2] She returned three weeks later with an acute swelling. Roentgenograms showed a retained molar root with extensive osteomyelitis of the mandible (Fig. 2). A draining fistula which had remained from the previous incision led to the affected bone. Chemotherapy by intramuscular and local administration (Fig. 3, left), removal of the infected tooth and sequestrectomy (Fig. 3, right) brought about the patient's rapid recovery.

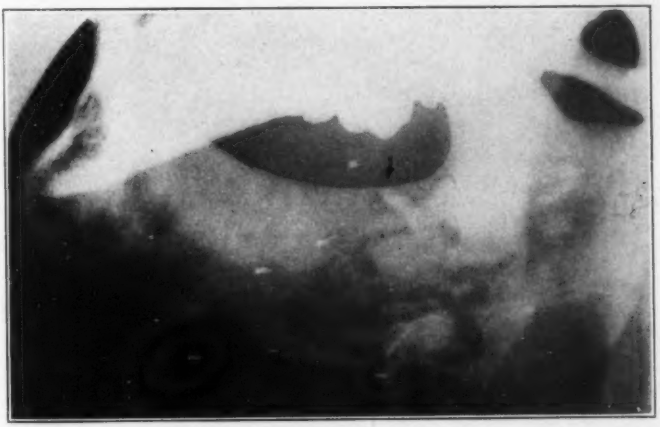

Fig. 2.—Developing osteomyelitis after submental phlegmon caused by tooth root (arrow) left in jaw

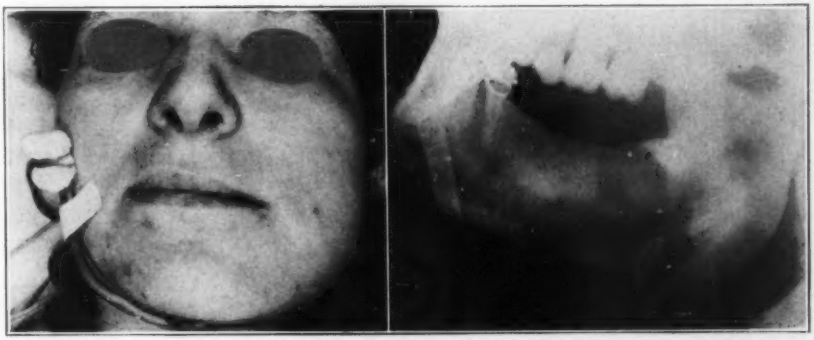

Fig. 3.—Left: Patient after sequestrectomy, with tube inserted into fistula for instillation of penicillin. Right: Roentgenogram taken after sequestration and saucerization. Note tube extending into tissue

2. Thoma, K. H., Acute Osteomyelitis of the Mandible Following Submental Phlegmon. *Am. J. Orthodont. & Oral Surg. (Oral Surg. Sect.)* 29:544 (October) 1943.

Fig. 4.—Acute osteomyelitis of the mandible

Surgical Treatment of Early Complications

Cellulitis and submaxillary, submental, sublingual, parapharyngeal and infratemporal abscesses may be treated with satisfactory results by combining the use of antibiotics with the removal of the cause. In general, extraction of the tooth is indicated, although occasionally incisors and bicuspids may be treated conservatively. The extraction of the infected tooth should be undertaken as soon as possible. There is no great danger of complications from this procedure if it is combined with the prophylactic use of penicillin to prevent bacteremia. In some cases the extraction wound provides a certain amount of drainage so that no other incisions are needed.

Osteomyelitis of the jaw is a complication which frequently develops from dental infection. Hematogenous infection and infection from furunculosis are rare. The tooth causing the acute infection is usually sore, but in widespread extension many adjacent teeth may be secondarily involved. Adequate roentgenograms of the jaws and teeth are essential in making a diagnosis. In most acute cases, extraction of the involved teeth is indicated as soon as a good penicillin level has been obtained, and often the disease can be arrested by the drainage through the extraction wounds combined with penicillin treatment.

Case 4

The patient was admitted to the emergency ward with the complaint of pain and swelling of the left side of the jaw.

He first noticed a painful swelling of the gingiva behind the last molar tooth. The jaw then started to swell. His dentist ordered a hot gargle and application of ice to the face, but there was no decrease in swelling.

On examination, a soft, diffuse, edematous swelling was noted on the left side of the mandible, which was tender to palpation. The submaxillary lymph nodes were enlarged and tender, and because of muscular trismus the patient could not open his mouth. His temperature was 99.6 F., pulse, 110 and white cell count, 12,000. Reaction to the Hinton test for syphilis was negative. Roentgenograms showed diffuse rarefaction consistent with the diagnosis of osteomyelitis (Fig. 4).

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Chemotherapy was instituted, and with the patient under intratracheal gas-oxygen-ether anesthesia the molars were extracted. After débridement of the alveolar wound, which included the removal of several sequestra, sulfanilamide and sulfathiazole powder was inserted with a strip of gauze saturated with petrolatum.

The patient was discharged from the hospital on the sixth postoperative day and followed in the outpatient department until the wound had completely healed.

Case 5

A case in which osteomyelitis was caused by furunculosis was seen recently.

A man, aged 36, showed clinical and roentgenographic evidence of osteomyelitis. A furuncle had formed in the subpreauricular region six months earlier, and residual tenderness persisted. Pain and swelling of the jaw developed two weeks before the patient's admission, but his dentist could find no infection associated with the tooth. However, he finally extracted the first molar. The second molar later became painful and loose and was extracted after penicillin treatment was started. The symptoms became worse, and a lateral jaw roentgenogram showed extensive osteomyelitis (Fig. 5, left). Radical saucerization and sequestrectomy was performed, and a rubber catheter was inserted for local instillation of penicillin (Fig. 5, right). The culture taken at the time of operation showed Micrococcus catarrhalis and Staphylococcus albus. Recovery was uneventful.

Comment.—The instillation of penicillin in concentration of 1,000 units per cubic centimeter through an inlying catheter assures concentration of the drug not attainable by intramuscular injection.

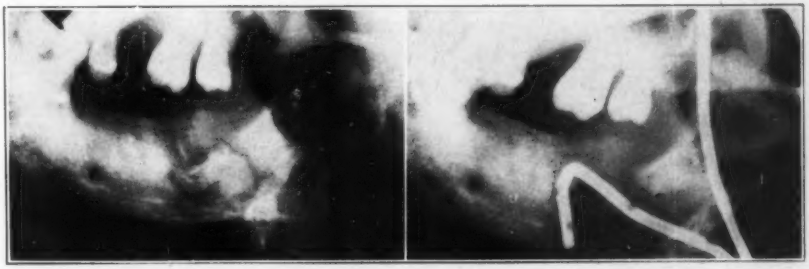

Fig. 5.—Left: Osteomyelitis of the mandible. Right: Roentgenogram taken after sequestrectomy and saucerization, and insertion of rubber catheter for instillation of penicillin

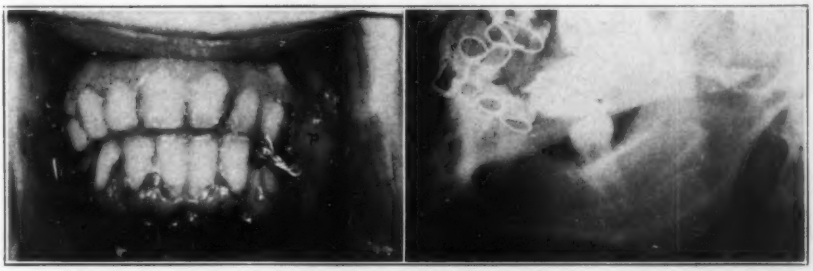

Fig. 6.—Left: Septic fracture of mandible with inadequate intermaxillary fixation. Tooth in fracture line is discharging pus (P) into the mouth. Right: Fracture with molar involved in fracture line

Fig. 7.—Tube inserted into incision at angle of jaw for local instillation of penicillin

In fractures, complication by infection often is caused by involvement of a tooth. Infection may penetrate from the gingival margin to the fracture, causing an abscess of the adjacent fascial spaces,[3] and result in osteomyelitis with extensive loss of bone. It is a safe rule to extract teeth in the fracture line even though they may be valuable for intermaxillary fixation. Today there are several good methods available for the fixation of jaw segments which have been made edentulous by such extractions. The following case illustrates the formation of a submaxillary abscess resulting from a fracture along a tooth.

Case 6

A woman, aged 23, had contracted a fracture of the mandible. The fracture was reduced and the jaw was immobilized by intermaxillary wire fixation. A submaxillary swelling developed with fever and leukocytosis. When the lip was retracted for removal of the wiring, the abscess broke intra-orally and a large amount of frank pus was discharged (Fig. 6, left). The tooth in the fracture line (Fig. 6, right) was removed and the mandible was again immobilized by intermaxillary wiring. The submaxillary abscess was evacuated and a rubber catheter was inserted for the local instillation of penicillin (Fig. 7). Sepsis ceased and bone repair followed uneventfully.

Comment.—The tooth in the line of fracture was the source of sepsis, and bony union was prevented so long as the tooth was retained.

Surgical Treatment in Advanced Cases

In some cases the use of antibiotics and the removal of the cause of infection does not result in resolution without operative interference to eliminate pus and

3. Thoma, K. H., Septic Compound Mandibular Fracture Complicated With Submaxillary and Pterygoid Abscess Treated With Penicillin. *Am. J. Orthodont. & Oral Surg. (Oral Surg. Sect.)* 30:158 (April) 1944.

necrotic tissue. If antibiotic treatment is not instituted before pus has formed and before bone necrosis has set in, more extensive surgical care is needed. Cases of this type are common because many patients do not present themselves for treatment until these complications have arisen.

In fascial abscesses the pus may be aspirated by means of a syringe, and the immediate injection of penicillin in dilution of 1,000 units per cubic centimeter may be beneficial. In most cases incision and evacuation of the pus followed by instillation of penicillin through a tube inserted into the abscess cavity give more satisfactory results. The advantage of this method over the aspiration technic is that penicillin or streptomycin can be instilled every three or four hours to supplement the parenteral administration. Similar treatment may be used in acute infection of an odontogenic cyst; the catheter being inserted into the cyst cavity, and enucleation of the membrane being postponed until the infection has subsided.

Case 7

A man, aged 54, contracted a compound comminuted fracture through a large cyst in the anterior part of the mandible (Fig. 8). His face swelled and he suffered severe pain. His temperature was 103 F., and the white cell count was 17,300. He received 48,000 units of penicillin every three hours, and on the following day, with the patient under local anesthesia, an incision was made beneath the chin for evacuation of the purulent contents of the cyst. A rubber catheter was inserted and sutured to the skin and the wound was closed. The intramuscular injections of penicillin were continued and supplemented with local instillations. The culture revealed the presence of Staphylococcus albus. After the acute infection had subsided the cyst was enucleated, the cavity was filled with fibrin foam and closed by suture, and skeletal fixation was applied to the jaw (Fig. 9). Five days later the patient was discharged. A roentgenogram taken eight weeks later showed satisfactory bone healing, so that the appliance could be removed. When tested, the jaw was found to have healed satisfactorily and all signs of infection had subsided.

In fractures complicated by osteomyelitis sequestrectomy usually is necessary and is best accomplished from an extra-oral approach. If the bone loss is not too great, union may be expected if the jaw is properly immobilized. I have had excellent results

Fig. 8.—Fracture through mandibular cyst

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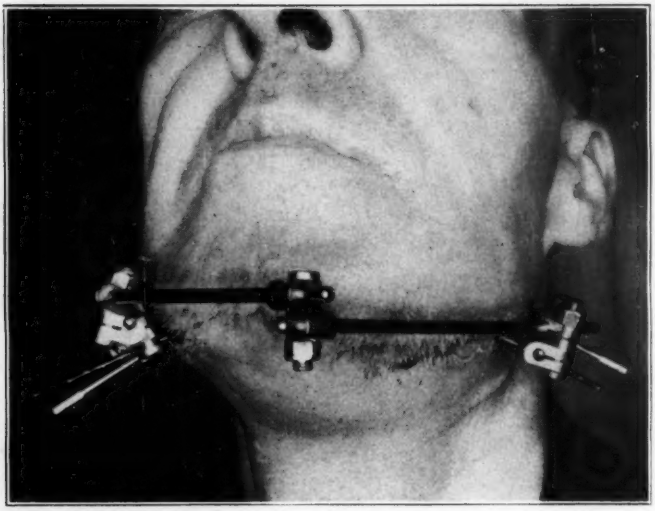

Fig. 9.—Skeletal fixation applied to immobilize fractured jaw after enucleation of cyst

with skeletal fixation, using pins in the anterior fragment, far removed from the infection, and my peripheral bone clamp on the posterior fragment in the infected region. Since use of the clamp does not involve drilling into the bone there is no danger of spreading the infection if one comes too near the infected region.

Case 8

A woman, aged 46, had been struck on the jaw six weeks previously and had contracted a fracture. She had received medical care, including penicillin treatment for four days. She

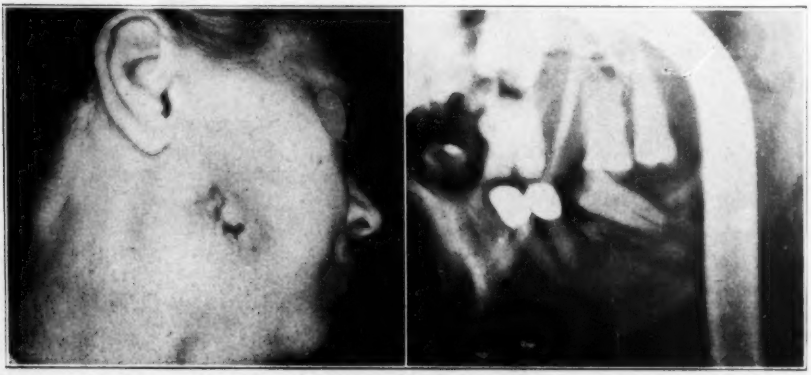

Fig. 10.—Left: Multiple fistulae on cheek caused by septic fracture. Right: Fracture line with infected teeth and osteomyelitis. The tube is an intratracheal catheter, the roentgenogram having been taken during operation

had a submaxillary swelling and multiple draining fistulas (Fig. 10, left). Roentgenographic examination revealed a fracture complicated by osteomyelitis. A molar extended into the fracture line (Fig. 10, right). The patient's temperature was 99.4 F. and the white cell count was 11,000. She received 32,000 units of penicillin every three hours, and two days later sequestrectomy was performed. A rubber catheter was inserted and the fractured jaw was immobilized by means of skeletal fixation. Pins were used in the anterior fragment and a peripheral bone clamp at the angle of the jaw. Seven days later the catheter was removed and two days later the patient was discharged (Fig. 11, left). The wound healed well (Fig. 11, right). The appliance was removed seven weeks after the operation, when a satisfactory union had been obtained.

In osteomyelitis the removal of necrotic bone, when completely sequestrated, may be a simple procedure, especially if an intra-oral approach is possible. In other instances the sequestrum may be encased or inaccessible, in which case an extra-oral approach becomes preferable. The bone is decorticated to expose the infected channels so that all necrotic bone can be removed. Saucerization should be carried out to eliminate overhanging margins. The wound is closed in layers, either completely or around a rubber catheter inserted into the region for the local instillation

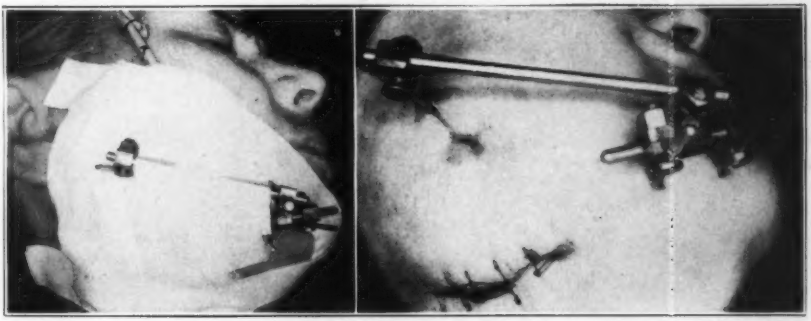

Fig. 11.—Left: Appearance after sequestrectomy and extraction of infected teeth. Fractured jaw was fixed with skeletal and clamp fixation, with tube (T) inserted for instillation of penicillin. Right: Appearance after ten days when sutures were being removed. Note healing of fistulae

Fig. 12.—Left: Osteomyelitis with pathologic fracture. Right: Appearance after excision of infected fragments. Catheter inserted into wound

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of penicillin or streptomycin as already recommended. The patients in cases 1 and 5 were treated in this manner.

In chronic osteomyelitis of very long standing, which has resisted treatment, a completely necrotic segment of the jaw may have to be excised. The continuity of the bone can be restored later by a bone graft. The following case serves as an illustration.

Case 9

A man, aged 46, had been treated for osteomyelitis of the mandible for two years. Several sequestrectomies had been performed in conjunction with penicillin treatment. In spite of this, the infection continued and finally a pathologic fracture resulted (Fig. 12, left). The patient suffered severe pain. A culture disclosed Bacillus coli and Staphylococcus albus; a smear showed Vincent's spirilla and fusiform bacilli. The patient was hospitalized and given both penicillin and streptomycin. After two days the diseased segment of the mandible was excised. The patient was given local treatment through a rubber catheter in addition to the intramuscular injections (Fig. 12, right). The wound healed promptly, and ten days after the operation the patient was discharged completely relieved. He is to return after six months for a bone graft to restore the continuity of the jaw.

Postoperative Treatment

The aftercare is important in all jaw infections. Treatment with the specific antibiotic should be continued until all signs of infection have subsided. In most oral cases, the patient receives a liquid diet high in protein, caloric and vitamin content. Infection depletes the vitamin stores in the body, and patients with severe or prolonged dental infection easily become dehydrated because of the difficulty or discomfort of ingestion. Intravenous infusions should be administered freely to supply the necessary fluid and electrolytes. Repeated blood transfusions greatly aid in improving the general condition of patients and they probably also help to overcome the infection. Oral hygiene, often neglected, is of prime importance to prevent secondary infection and to minimize sepsis.

Summary

In the various complications that may follow dento-alveolar infections, a careful bacteriologic investigation is indicated. The infection is generally caused by a mixed bacteriologic invasion, and the various organisms must be identified by means of smears and aerobic and anaerobic cultures. Antibiotic treatment should be instituted both to prevent spread of the infection through bacteremia as well as to cure the disease. The intramuscular injection may be augmented by the local instillation of the antibiotic agent in the septic zone by means of a catheter inserted through the wound before it is closed, in cases in which surgical interference is needed to evacuate pus or remove sequestra. The use of antibiotics is not sufficient in many of these cases, but should be combined with good and effective surgical treatment. In addition, good postoperative care is needed to ensure quick recovery without relapse.—*1180 Beacon Street, Brookline, Boston.*

HISTOLOGIC COMPARISONS OF LOCALIZED FIBROUS DYSPLASIA OF BONE AND OSSIFYING FIBROMA

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IN RECENT years there have been differences in opinion and in the nomenclature associated with particular changes occurring in bone. Many writers have used terms rather loosely when dealing with bone lesions and to such a degree that in many instances the terms have had little meaning.

After a review of the literature it was found that several investigators are beginning to recognize the term "fibrous dysplasia" and agree that it has a rightful place in the description of some of the specific histopathologic changes occurring in bone. It is the premise of this paper to correlate the multiple and duplicate terms which have been used in the identification of benign bone lesions, heretofore classified as ossifying fibroma, fibro-osteoma and fibrous dysplasia of bone. The terms employed are all used to describe various phases of a single pathologic process with special emphasis on histopathologic, clinical and roentgenographic aspects.

Possible Etiologic Factors

The classification of this process is extremely difficult because many workers differ in their beliefs as to its origin. Some classify this lesion with benign forms of bone tumors such as fibrosing osteoma, osteodystrophia, ossifying fibroma or in one group as osteitis fibrosa. The opinions of many have changed in the past few years, many now believing that this term does not describe the pathologic condition which actually exists; furthermore, it is not the picture of inflammatory response. Thoma and others are inclined to agree with Furedi[1] who in 1935 made a series of studies describing and classifying the ossifying fibromas which will be discussed. Lichtenstein and Jaffe,[2] Albright,[3] and Schlumberger[4] have recognized other changes which occur in bone and which resemble very closely those in the ossifying fibroma group, yet they feel that there are some distinct histopathologic differences. These they term "fibrous dysplasia."

Other factors which might be considered as etiologic are trauma and inflammation. Inflammation, in the opinion of most authorities, can be excluded. Trauma, on the other hand, has been an important factor in the histories of many of these cases. Consequently, it may be considered as a definite contributing factor.

Since ossifying fibromas at some time or another have been classified under osteitis fibrosa, it is pertinent here to discuss briefly some findings in von Recklinghausen's disease and Paget's disease. We know that in von Recklinghausen's disease

1. Furedi, A., A Study of So-Called Osteofibromas of the Maxilla. *D. Cosmos* 77:999 (October) 1935.
2. Lichtenstein, L. and Jaffe, H. L., Fibrous Dysplasia of Bone. *Arch. Path.* 33:777 (June) 1942.
3. Albright, F., Butler, A. M., Hampton, A. O., and Smith, P., Syndrome Characterized by Osteitis Fibrosa Disseminata. *New England J. Med.* 216:727, 1937.
4. Schlumberger, H. D., Fibrous Dysplasia of Single Bones (Monostotic Fibrous Dysplasia). *Mil. Surg.* 99: 504 (November) 1946.

there are multiple disseminated lesions existing in various regions of the skeleton. The cause of this disease is usually an adenoma of the parathyroid gland. This causes hypercalcemia; consequently, there is a withdrawal of calcium from the bones, and lesions similar to ossifying fibromas may be found in these patients. Roentgenographically, these regions of bone destruction are difficult to differentiate from one of many other entities which will be discussed. The blood picture of osteitis fibrosa cystica is one of increased serum calcium and phosphatase with a decrease in inorganic phosphorus. This, of course, accounts for the excessive excretion of calcium and phosphorus in the urine. In Paget's disease the calcium and phosphorus levels are for the most part normal, but there is an increase in the serum phosphatase. The latter condition is one which resembles ossifying fibroma more directly, although either disease might be confused in roentgenographic studies of solitary lesions. The aforementioned disease entities, especially osteitis fibrosa cystica, represent disseminated or multiple lesions of the ribs, long bone or calvaria. Lichtenstein and Jaffe[2] were confronted with cases of disseminated lesions of fibrous dysplasia in bone. We are interested in the manifestations of this lesion of fibrous dysplasia as it appears locally and are aware of the fact that the formation of fibrous connective tissue is often the normal response of tissue to injury or stimuli of high intensity. Therefore, it is reasonable to assert that there are varying stages in the reparative process. It is a generally accepted opinion that one of the early changes in the structure of bone, after trauma or other stimuli, is the proliferation of fibrous connective tissue in the haversian spaces with increased numbers of small isolated vascular channels. Fibrous dysplasia of bone duplicates this picture, but if the process were to continue, the ultimate should resemble very nearly that of ossifying fibroma. The findings of investigators who have devoted considerable study to the classification of benign bone tumors bear out some of these statements, as do the findings of those who have studied both localized and disseminated lesions of fibrous dysplasia.

Thoma[5] said that this disease occurs more often in women than in men. The patient is usually without symptoms, other than facial asymmetry, which is the case with other slow growing benign tumors. The site most frequently involved by ossifying fibromas is the mandible. The maxilla also is involved by this neoplasm but with not nearly the frequency, owing to the anatomic position and relation of the lower jaw to the rest of the skull. The age of incidence is usually the second and third decades of life. There may be multiple lesions in a single bone,[6] or the tumor may involve the whole of the tuberosity. There is a type which is commonly found to obliterate the maxillary sinus completely, with invasion and expansion of the malar bone and compression of the orbit.[5]

Clinical Findings in Ossifying Fibroma

Furedi,[1] in 1935, studied a series of cases of the so-called osteofibroma of the maxilla. She classified this tumor according to the type of osseous change which was predominant as evidenced by the roentgenographic and microscopic findings. The changes occurring in the first group were hyperostotic, which included condensing or sclerotic types of change in bone. The second group comprised hypostatic or the rarefying and porotic variations, and the changes in the last group were those which resembled very nearly normal bone. The roentgenographic aspects of this tumor and the alterations in the bone tissue which show as mutations in the roentgenograms will be discussed under another heading.

5. Thoma, Kurt. *Oral Pathology*. Second Edition. St. Louis: C. V. Mosby Company, 1944, p. 1328.
6. Gullifer, W. H., Osteitis Fibrosa and Associated Lesions of the Jaws. *J.A.D.A.* 25:253 (February) 1938.

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It was suggested in preceding statements that trauma was thought to play an important part as a causative agent in the formation of ossifying fibroma or fibrous bone dysplasia. In the 14 cases studied by Furedi, it was found that none were thought to have been influenced by trauma and that all the blood values were normal. Further analysis of her findings revealed that bacterial foci and, in four instances, minute bacterial foci were found in the hyperostotic cases. Three of these patients had teeth. Roentgenographically, these teeth appeared normal. In the rarefying types there were no evidences of bacterial invaders. Furedi predicated that even though she did not have sufficiently vast material on which to base many conclusions, in spite of the variety of the roentgenographic and microscopic findings, that in accordance with the clinical aspects hyperostotic and hypostatic types belong to one group, that of localized osteitis.[1]

Gullifer[6] stated that other changes in bone similar to osteofibroma result in the mandible and maxilla. He cited instances of bone cyst formation. He has found that the highest incidence falls between the ages of 5 to 20 and that the region involved is the mandible. This condition is caused by osseous changes following trauma to cortical bone, which produces changes in the vascularity of the cancellous bone. These new vascular channels are formed to compensate for the change in the bone. This compensatory hyperemia gives a radiolucent appearance on the x-ray film. If similar injury of the maxilla occurs, giant-cell tumors rather than bone cysts are apt to result, owing to the thinness of the cortical plate in maxillary bone. Boyko[7] reports a case of a woman, aged 22 years, who had a swelling and pain in the left side of the mandible. Her history revealed that she had been injured in an automobile

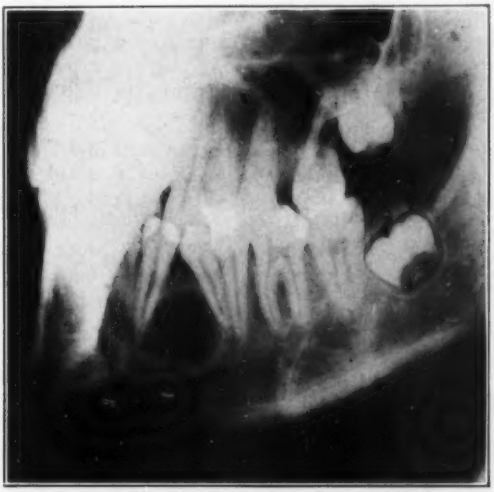

Fig. 1.—Radiolucent areas are suggestive of cyst formation but may be caused by presence of either actual fluid or fibrous connective tissue

7. Boyko, G. V., Fibrous Osteitis (Traumatic Bone Cysts) of the Mandible. *Arch. Clin. Oral Path.* 2:342 (September) 1938.

accident. The pain occurred only during masticatory excursions. The patient was operated on but the disease recurred in four years. The diagnosis by the pathologist was traumatic bone cyst or fibrous osteitis. This again offers some proof that these tumors which resemble new bone formation are often associated with trauma and that they often undergo cystic changes.

Wilkinson[8] reports a case of a woman, aged 38, who first had a hard bony swelling in the right side of the maxilla, extending from the tuberosity to the right lateral region. The zygoma seemingly was displaced buccally, and the palate and the alveolar ridge were markedly thickened. Results of nasal examination were negative. The mucous membrane was of normal color and contour and there was no sign of inflammatory response. Roentgenographically, this tumor occupied the whole antral space and measured 5 by 4¾ by 2½ cm. This exemplifies the type of benign bone-forming tumor which is highly expansile and has a great tendency to distort adjacent bone structure, as was the malar bone in this case. It was mentioned in preceding statements that these benign bone-forming tumors were for the most part asymptomatic, with swelling and facial asymmetry the most cardinal symptoms. This is true. However, Roberts[9] reports a case of a similar ossifying fibroma which obliterated the entire antral space on one side and occupied the region of the right tuberosity. This patient was menaced with tinnitus of such intensity that his mere existence was intolerable. After the removal of this tumor the patient's tinnitus subsided.

Clinical Aspects of Fibrous Dysplasia

The clinical picture of the lesions found in fibrous dysplasia in many ways resembles that just given for ossifying fibromas. Lichtenstein and Jaffe, Albright, and Schlumberger and co-workers have given us most of the information available in the current literature on this subject. Lichtenstein and Jaffe are concerned with what is termed disseminated fibrous dysplasia of bone, as their studies deal with lesions in various regions of the skeleton, such as ribs, long bone and pelvis, which we cannot discuss here. They did, however, find some lesions in the maxilla and mandible. In the cases of disseminated fibrous dysplasia, they found that many of the patients exhibited Albright's syndrome. This collection of symptoms consists of pigmentation of the skin, premature sexual maturation, hyperthyroidism, premature skeletal growth and, occasionally, cardiovascular anomalies. In these cases there may be evidence of changes in the facial bones and in the calvarium in the region of the sphenoid bone or hypophyseal fossa. This, according to some investigators, accounts for the endocrine malfunction. They feel that there is sufficient pressure exerted by the osseous changes to influence endocrine activity. It is the opinion of Lichtenstein and Jaffe that the skeletal lesions apparently result from perverted activity of the bone mesenchyme, the result being involvement of one or several bones. From the foregoing information it is reasonable to assert that in the event the practitioner should find a solitary lesion in the maxilla or mandible during the routine roentgenographic examination of the dental organs, it behooves him to see that further roentgenographic studies are made of the extremities.

Schlumberger[4] of the Army made a study of 67 cases of monostotic fibrous dysplasia (limited to a single bone) 14 of which involved the calvarium and facial bones, 7, the maxilla; 5, the calvarium; and 2, the mandible. One case involved the temporal

8. Wilkinson, F. C., Benign Bone-Forming Tumors of the Jaws. *Brit. Dent. J.* 77:341 (December 15) 1944.
9. Roberts, E. P., Tinnitus and Impaired Hearing Caused by an Intra-Osseous Osteogenic Fibroma of the Maxilla. *Ann. Dent.* 1:193 (March) 1943.

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bone and mastoid process. The symptoms in these cases were not too outstanding except that the lesions involving the frontal bone caused the patient to suffer with headaches for about seven months prior to the diagnosis. In the case which involved the mastoid process the patient, a young man, was menaced with earaches and aural discharge until he was 12 years old. Schlumberger made two important findings in his study: (1) that there was no cutaneous pigmentation like that found in the disseminated types of fibrous dysplasia of bone, (2) that there were no congenital defects present in the monostotic cases.

Roentgenographic Aspects

Consideration of some of the physiologic changes which might ensue in bone after intense stimuli such as trauma was mentioned briefly in the foregoing paragraphs. To be more explicit some of the alterations produced on the x-ray film should be given. For example, increased circulation in bone causes rarefaction of the osseous structures. There is an increase in the size of the medullary spaces if hyperemia occurs, with a diminution of the bone trabeculae in size and number. Even though the architecture of bone is modified, the chemical constituents remain unaltered. In cases in which circulation is impaired the characteristic osteosclerotic appearance is the result. The presence of osteogenetic and osteoporotic regions in seemingly normal bone is of unknown origin.

The roentgenographic aspects of ossifying fibromas and fibrous dysplasia may be considered together because of their great similarity of appearance in the roentgenogram.

In the disseminated types of fibrous dysplasia there may be present a number of discrete rarefactions which reflect the displacement in the affected region of the cancellous portion of the bone and the adjacent cortical plate. There may be present a turbid or mottled appearance, owing to the fact that there are regions of new immature formation of bone. Figure 1 illustrates this solitary type of lesion. This is the roentgenogram of a young white man, aged 16, who had a painless nontender swelling in the mucobuccal fornix of the right mandibular bicuspid region. The patient said that it had been growing after an automobile accident in which he had been thrown against the windshield of his machine. It was thought that since the periphery of this lesion was so well demarcated and the central area so radiolucent, it was surely a bone cyst containing fluid. However, when the lesion was removed it was found that this was not the case. Before an opening was made directly into the tumor, a large gage needle was introduced in an attempt to draw off any cystic fluid which might be present. No fluid was withdrawn, which was apparent proof that the lesion was not a true cyst. The overlying cortical plate was removed and the tumor was completely enucleated.

Another interesting case is that of a white girl, aged 15, who for approximately one and a half years had noticed a small lump on the left side of the mandible about the size of a pea. The lump gradually increased in size over a period of one year and frequently caused a dull intermittent pain. Examination of the patient revealed a well nourished, well developed young lady with slight asymmetry of the face caused by a bulging along the inferior border of the left body of the mandible. There was present a small tumescence, measuring approximately 6 mm. in length and 5 mm. in width, protruding from the left body of the mandible along the inferior border on the medial aspect (Fig. 2). The mass was extremely hard and lobulated. The tumescence was nonpainful and nontender and apparently noninflammatory. The pathologic report confirmed a preoperative diagnosis of ossifying fibroma.

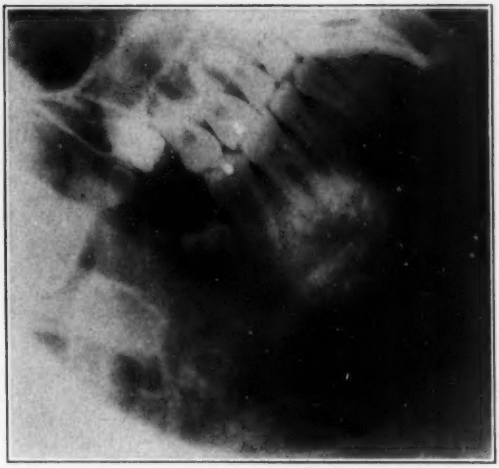

Fig. 2.—Size, location and contour of mass

The ossifying fibromas have a fairly characteristic appearance in the roentgenogram. The tumor is of regular contour and less calcified than normal bone. Usually there is ossification subperiosteally, if the tumor is of considerable size, which gives the mass a distinct outline. The periphery of these tumors is usually definitely demarcated in the roentgenogram. This smooth, definite outline rules out malignancy according to Geschickter.[10] Many psammomas (fibrous calcified masses) lie throughout the tumor; this is also characteristic of the ossifying group of tumors. It is the feeling of Gullifer[6] that a positive roentgenographic finding is that of the intact lamina dura about the teeth, which approximates the margins of cystic lesions. These growths must not be confused with radicular cysts, whose origin is entirely different. Another differential diagnostic point that should be made is the comparison of formation of cementoblastoma to that of ossifying fibroma. The formation of cementomas occurs in three principal stages. The first is one of radiolucency in which there is a proliferation of soft tissue which might be mistaken roentgenographically for periapical infection producing an osteolytic appearance. In the second stage there may be evidences of intermittent regions of calcification fibrosis which might be misinterpreted as small ossifying fibromas. Third is the calcified stage in which there is a thin radiolucent membrane surrounding a calcified mass. These phases might be confused easily with those of one of the many benign bone-forming tumors.

Histologic Comparisons and Variations

To make explicit suppositions regarding the histologic differences of the two processes discussed is not easy. In cases in which the microscopic appearance of related lesions such as fibrous dysplasia and ossifying fibromas resembles each other so closely, it is often difficult to demonstrate definite contrasting features. Even those who have had much experience in diagnostic pathology have divergent opinions. This is exemplified in Schlumberger's[4] cases that were submitted to pathologists.

10. Geschickter, C. F. and Copeland, M. M., *Tumors of Bone (Including the Jaws and Joints)*. Revised Edition. New York: *Am. J. Cancer*, 1936, p. 832.

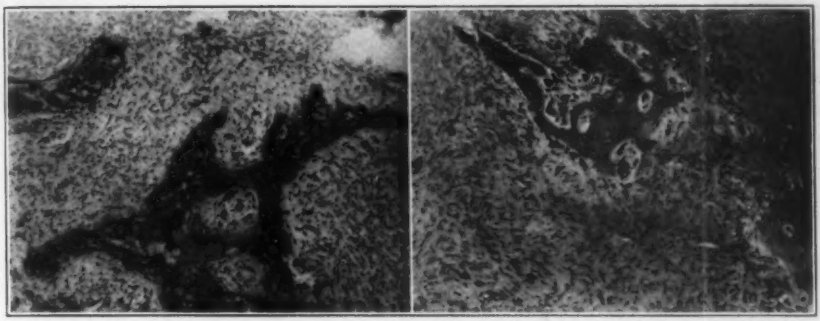

Fig. 3.—Left: A few isolated trabeculae are demonstrated with massive amounts of fibrous connective tissue occupying rest of field. Fibroblasts are immature large spindle cells, arranging themselves in semiwhorled fashion, some of which are adjacent to new vascular channels. Right: Some evidence is seen of a small number of giant cells, indicative of some bone destruction

Only about 28 per cent of the diagnoses were in favor of fibrous dysplasia of bone. Other diagnoses were: osteitis fibrosa, giant-cell tumor, ossifying fibroma, fibrosarcoma, bone repair, osteodystrophia and traumatic bone cyst.

The microscopic picture of each of these processes has deviations. In the case of fibrous dysplasia, the predominant tissue is, of course, fibrous connective in type. It may be arranged in large bundles or whorls and is usually found surrounding new vascular channels. Throughout the section may be small fragments of bone which do not form haversian systems. The formation of haversian systems depends for the most part on what stage of the process existed prior to intervention. The lesions, even though in some instances in the ribs or long bones, show great resemblance to those of the maxilla and mandible. The lesions of fibrous dysplasia assume many modifications. They may have a fibrous connective tissue stroma with newly formed haversian systems and some evidence of osteoclastic action, or they may have the appearance of spindle cell stroma accompanying multiple dilated vascular channels. However, in the tumors of the maxilla and mandible to which rightly may be assigned the term fibrous dysplasia of bone, we find that for the most part the picture is one of many haversian systems with varying amounts of fibrous connective tissue

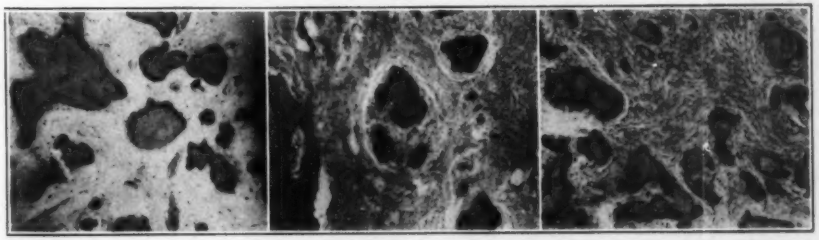

Fig. 4.—Several rather small amorphous calcified masses may be seen. Left: Fibrous connective tissue is not dense type found in Figure 3 or in accompanying sections. There is no attempt toward formation of haversian bone, but particularly there is a proliferation of new vascular channels

proliferating within the trabeculae. Many pathologists fail to find evidence of giant-cell activity in these lesions nor do they find any lymphocytic response as is often the case in the disseminated types of fibrous dysplasia. One difference between the fibrous dysplasia and ossifying fibromas is the presence of giant-cell activity. Most investigators feel that there is an absence of giant cells in the ossifying fibroma group. The presence of these multinucleated cells is evidence that there are alternating amounts of bone destruction with the replacement of massive amounts of fibrous connective tissue. In ossifying fibromas the microscopic picture is one which may more closely resemble that of normal bone. There is a definite attempt at the formation of haversian systems and in the intertrabecular spaces the proliferation of fibrous connective tissue. Giant-cell activity in these lesions is not too frequently seen, and it is thought that in many instances if this process were to continue the ultimate result would be osteoma. Several representative sections of these tumors have been taken which demonstrate these lesions and their variants. The sections shown here are from lesions which have been diagnosed by the pathologists as ossifying fibromas and fibrous dysplasia of bone.

It is my opinion that these differences in structure are for the most part variants of

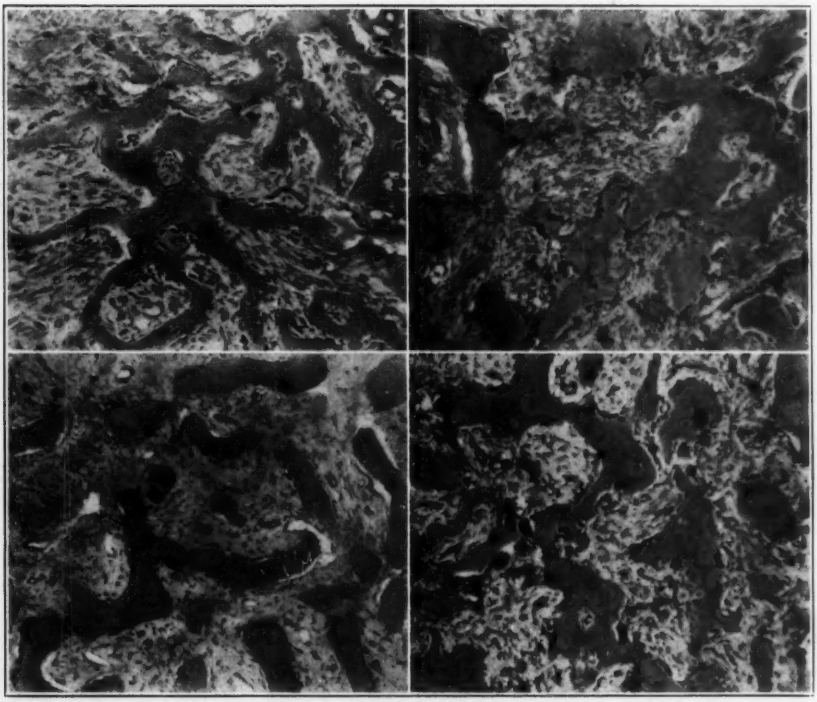

Fig. 5.—More trabeculation of bone is elicited. Intertrabecular spaces are still obliterated with fibrous connective tissue. Present in these sections is more activity of the multinucleated cells shown dispersed throughout the trabeculae (below, right)

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a single neoplastic process, but when such a predominance of fibrous connective tissue stroma exists the tumor can no longer be called ossifying fibroma; therefore, fibrous dysplasia identifies and describes the cytologic metamorphosis more explicitly. To simplify the identification of these lesions the sections taken are divided into five different groups, the first of which shows fibrous dysplasia with the massive predominance of fibrous connective tissue. Figures 4 to 7 show increased tendencies toward formation of a more dense type of bone tumor with lessening of the fibrous connective tissue stroma and predominance of dense haversian bone, or osteoma.

Conclusions

1. After reviewing these photomicrographs perhaps one can in some way see the resemblance and yet the variations and modifications in these benign bone lesions.
2. Ossifying fibromas and fibrous dysplasia of bone should be considered as variants of one neoplastic process.
3. Even though it is the nature of this neoplasm to be quite cellular, there are no records of its undergoing sarcomatous change.
4. Usually there are no diseases of bone in the remaining part of the skeleton, in

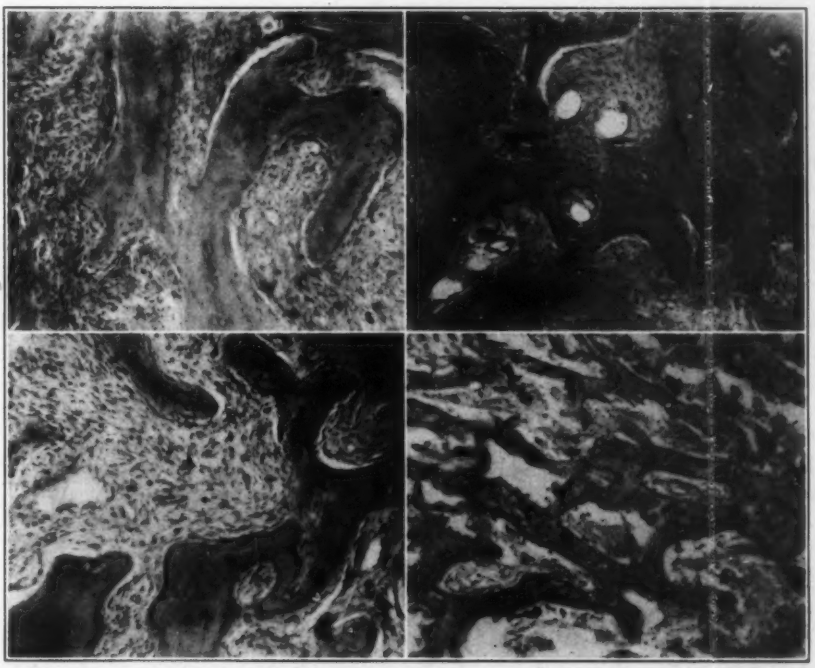

Fig. 6.—Sections more nearly elucidate process representative of ossifying fibromas. Upper left: Manifest formation of larger trabeculae with increased density. Upper right and lower left: A similar histologic picture may be seen. There are decreasing amounts of fibrous connective tissue and new attempts toward formation of haversian bone, as well as some small vascular channels which have not yet been displaced by ossifying process

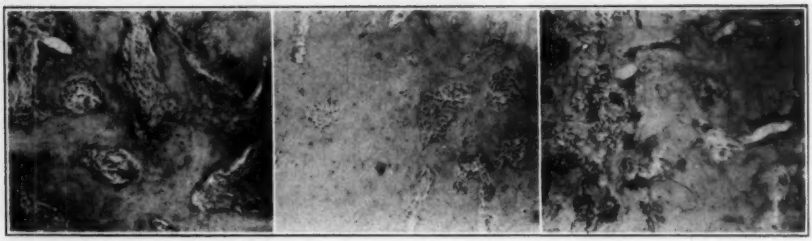

Fig. 7.—Sections show evidences of dense bone formation. Left: Some degree of fibrous connective tissue change is still visible. Center and right: Spaces between trabeculae have practically been obliterated, owing to excessive osteoblastic activity. Fibroblasts or osteoblasts can be seen crowded into small areas being engulfed by haversian bone

localized or monostotic bone lesions, and the calcium and phosphate levels remain within normal limits.

5. It is felt that even though these tumors tend to recur with high frequency they should not be operated on radically.

6. The histopathologic change of fibrous dysplasia is being recognized more and more by those who have an opportunity to read material pertaining to pathology, and it should earn a rightful place in our diagnostic nomenclature.—*Department of Oral Surgery, University of Michigan.*

TEACHING GRANT IN ORAL CANCER

Greater development of teaching in the field of oral cancer at The Ohio State University College of Dentistry has been made possible through a grant of $4,990 from the United States Public Health Service.

Announced by Dean Wendell D. Postle, the grant is one of the first made to a dental college by the Research Grants Division of the National Institute of Health. Administration of the expanded cancer teaching program will be handled by Hamilton B. G. Robinson, professor of oral diagnosis and pathology, The Ohio State University College of Dentistry.

The grant, recommended by the National Advisory Cancer Council, will facilitate the teaching of pathology, diagnosis and therapy of oral cancer by making possible the expanded activity of present personnel and employment of new personnel.

"Clinics, microscopic conferences, seminars and lectures will be used," Dean Postle said. "These will emphasize the importance of cancer, in general, and oral cancer, in particular."—*The Ohio State University.*

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THE USE OF OXIDIZED COTTON IN DENTAL HEMOSTASIS

Alvin S. Nathan, D.D.S., M.A., B.S.,
New York

From the earliest days, man has been concerned with the problem of bleeding. Without going into a historical review, it is sufficient to recall that this concern was with those who, because of injury, bled easily and whose blood failed to clot. Later, this concern was directed towards those who, because of surgical procedures, came into the same category.

Innumerable studies have been made as to the cause of excessive bleeding, and many methods have been evolved and tried to control it. It is not my purpose to recapitulate these efforts. It is, rather, to present a new hemostatic agent.

This investigation was undertaken at the suggestion of Frantz,[1] with the primary purpose of testing the value of a new hemostatic agent, oxidized cellulose, in the control of hemorrhage in the oral cavity. Much previous work had been carried on by Frantz[2] and her associates at Columbia University, and it was with her cooperation that it was decided to undertake an evaluation in the Division of Oral Surgery. This report covers our experience in a series of 100 clinic cases.

As Frantz[2] stated, the work she originally undertook was not for a hemostatic agent, but for the study of the response of various animal tissues to soluble cellulose. Her work in this sphere had been preceded by about thirty years of continuous investigations at Columbia University for a nonirritating, absorbable material that could be used to prevent adhesions in repair of a tendon in its sheath.

This cellulose, first in the form of oxidized cotton, later as oxidized paper, and then as oxidized gauze, had been prepared by Kenyon and his collaborators[3, 4] and was, through the courtesy of Kenyon, studied in advance of his publication. It was soon found that the material was nonirritating and that it disappeared in animal tissues. Other uses, therefore, were considered and it was tried in clinical cases of neurosurgery by Putnam[5] as a carrier for thrombin.

After much laboratory data had been collected concerning soluble cellulose in these forms, the material was released for use in general surgery. "The most extensive clinical trials to date have been at the Columbia-Presbyterian Medical Center and the Mayo Clinic."[2] As mentioned, the material was used first in conjunction with thrombin, but it was soon noticed that it had excellent hemostatic properties of its own, and since then has been used by itself.

Properties of the Product

The cellulose was studied by us first in the form of gauze and then in the form

This study was conducted in the Division of Oral Surgery, School of Dental and Oral Surgery of the Faculty of Medicine, Columbia University, New York.

1. Frantz, V. K., Clarke, H. T., and Lattes, R., Hemostasis With Absorbable Gauze. *Ann. Surg.* 120:181 (August) 1944.
2. Lattes, R., and Frantz, V. K., Absorbable Sponge Tests. *Surg. Clinics North America* 121:894 (June) 1945.
3. Yackel, E. C., and Kenyon, W. O., Oxidation of Cellulose by Nitrogen Dioxide. *J. Am. Chem. Soc.* 64:121 (January) 1942.
4. Unruh, C. C., and Kenyon, W. O., Investigation of the Properties of Cellulose Oxidized by Nitrogen Dioxide. *J. Am. Chem. Soc.* 64:127 (January) 1942.
5. Putnam, T. H., Use of Thrombin on Soluble Cellulose in Neurosurgery. *Ann. Surg.* 118:127 (July) 1943.

of cotton. As originally prepared, this product was obtained by oxidizing long fibered cotton with nitrogen dioxide for seven hours. As reported by Frantz[6] it has the appearance of ordinary surgical cotton, slightly off-white, but more friable. It is also soluble in dilute aqueous alkalis because of extensive carboxyl group formations during oxidation.[3] It does not withstand sterilization in the autoclave but keeps its tensile strength when boiled in water for three minutes. As this does not destroy spores, it was not suitable sterilization for clinical use, and as the materials are now packaged they are sterilized by formaldehyde.*

Both products are slightly harsher than unoxidized material, readily absorbable, free of nitrogen and slowly soluble in 0.15 molar solution of sodium bicarbonate, whose pH approximates that of blood.[2] Oxidized cellulose is relatively nonirritating, and implants of it are absorbed in varying lengths of time, depending on the amount introduced into the wound, the extent of operative trauma to the tissue and the amount of blood present.

Use in Oral Surgery

When first used for cases in oral surgery, the form selected was gauze. Strips were cut in suitable sizes for insertion into the sockets or regions involved. Because of the friability of the coarse meshed material, this method was found inconvenient at times. When cotton became available it was substituted for gauze and was found more convenient to handle.

In using oxidized cotton, pieces are cut into suitable sizes under aseptic conditions. At first the socket or bleeding area was quite heavily packed. As a result of experience, however, it has been found that better results are obtained in the use of the least number of small pieces, usually one quarter inch square, necessary to control the bleeding satisfactorily. They are inserted into the socket, or, if the bleeding is gingival, around the gingival margins.

When large pieces of oxidized cellulose were used it was noticed that there resulted a marked extrusion of the cotton or the clot. Breakdown with secondary bleeding occurred easily and probably was caused by trauma resulting when the patient closed the mouth.

With the exception of one or two cases, it was noticed that the regions into which the cellulose was packed became swollen. The adjacent areas frequently became indurated and, in some instances, ecchymotic. This swelling, in our opinion, was caused by two factors: (1) the absorbability of the cotton and its resultant expansion in the socket, and (2) the immediate reaction of the tissues to the acidity of the material. Shortly after the cellulose was inserted into the socket or bleeding area it became engorged with blood and took on a dark red appearance. Structurally, in most places, it was not like a clot but was a sticky, gelatinous mass. When seen twenty-four hours or more after insertion, the material appeared smooth, shiny and still gelatinous. In no instance, however, did any infection result from the insertion of the gauze or the cotton.

To date, 100 patients with hemorrhage have been treated with oxidized cotton. Of these, 80 were considered "normal" or average cases, generally encountered. The remainder were of special types and will be discussed in a separate report.

For the purpose of our study, the accompanying chart was prepared. It was used for all patients treated either prophylactically or postoperatively, and all pertinent data were recorded.

6. Frantz, V. K., Absorbable Cotton and Gauze. *Ann. Surg.* 118:116 (July) 1943.

*Gauze and cotton, processed by Tennessee Eastman Corporation, are sterilized and packaged by Parke, Davis & Company and Johnson & Johnson.

Fully three fourths of the patients gave no history of bleeding, nor of any operations which might have a bearing on the condition. Of the remaining 25 per cent, the majority of the patients usually complained of continuous bleeding for one to several days after extractions; the others gave vague, general information as to "secondary hemorrhage" (Table 1).

Primary Hemorrhage

In the patients with primary bleeding, nearly half had been bleeding from immediately after the extraction or operation until forty-eight hours later. Bleeding from soft tissue represented 63 per cent; from bone, 35 per cent. A general ooze accounted for 75 per cent of the bleeding, the remaining 25 per cent being closely divided among arterial, venous, and capillary types. Routine operations had been performed on 50 per cent of the patients, complicated operations on 21 per cent, and complex operations on 29 per cent.

Type of packing or hemostatic agent used.....

Case number

Patient's name age color sex

Previous history of bleeding, if any

Operations, if any

Medical history

Bleeding Tendency	Secondary Hemorrhage
1. Previous history of bleeding or clinical history	1.
2. Duration of bleeding	2. .....
3. Type of bleeding	3.
A. soft tissue ... B. bone	A. soft tissue .... B. bone
a. general ooze	a. .....
b. arterial	b. .....
c. venous	c. .....
d. capillary	d. .....
4. Type of clot	4.
5. Surgery	5.
a. routine (simple extraction)	a. .....
b. complicated (fractured root)	b. .....
c. complex (impaction, flap)	c. .....
6. Postoperative reaction after packing or hemostatic treatment	
a. pain	a. .....
b. swelling	b. .....
c. necrosis	c. .....
d. pyrexia	d. .....
7. Healing time	7. .....
8. Allergic manifestation	8.
9. Photography (preoperative or postoperative)	
10. Comments.	

Chart used for recording data in all cases

Table 1.—Analyses of eighty cases

Reactions	Primary Hemorrhage	Secondary Hemorrhage
Number of cases	68	12
Some history of bleeding	14	0
Bleeding time after extraction	Up to 48 hr.*	24-96 hr.†
Soft tissue bleeding	43 (63%)	10 (83%)
Bone bleeding	24 (35%)	2 (17%)
General ooze	51 (75%)	7 (60%)
Arterial	5 (7%)	0
Venous	5 (7%)	0
Capillary	7 (10%)	0
Routine operation	34 (50%)	3 (25%)
Complicated operation	14 (21%)	4 (33%)
Complex operation	20 (29%)	5 (42%)
Pain after use of oxidized cellulose	4 (6%)	1 (8%)
Swelling after use of oxidized cellulose	65 (95%)	8 (67%)
Necrosis after use of oxidized cellulose	0	0
Pyrexia after use of oxidized cellulose	0	0
Healing time	2-3 days	2-5 days

Percentage values are given as to the nearest whole numbers.

*The average lapse of time, immediately after extraction, during which bleeding occurred.
†The average elapsed time after operation during which no bleeding occurred.

In all these cases, the oxidized cotton was simply inserted into the socket or bleeding area, as previously detailed. The patient was kept under observation until the bleeding stopped. Usually the response was very rapid. In three or four cases, additional pieces of oxidized cotton were inserted to control the bleeding completely.

The use of the oxidized cotton resulted in pain in 6 per cent of these cases. Local expansion occurred in 97 per cent of the cases. No necrosis was observed, nor signs of pyrexia. The time required for healing averaged from two to three days. No patient showed any allergic manifestations. As a group, the patients with primary bleeding represented 85 per cent of the total number.

Secondary Hemorrhage

Of the patients with secondary hemorrhage, the remaining 15 per cent, none gave any history indicative of bleeding. In these cases, the bleeding started any time between twenty-four and ninety-six hours after operation. The type of bleeding which occurred appeared to represent soft tissue in 83 per cent of cases and bone in 17 per cent. In both categories, the general ooze occurred in the vast majority of cases. The clot was missing in about 40 per cent, was stringy and unorganized in 50 per cent and broken down and necrotic in 10 per cent.

Routine operation (simple extraction) accounted for 30 per cent of the bleeding, complicated operation (fractured root) for 30 per cent, and complex operation (impaction, flap) for the remaining 40 per cent.

In slightly less than 50 per cent of the cases of secondary hemorrhage the sockets were cleansed to remove the old clot and to permit fresh bleeding. Then the socket or area was treated with oxidized cotton. The remaining cases were controlled by in-

sertion of the cotton into the socket or by laying it over the incompletely formed clot.

Closely simulating the situation found in primary bleeding, pain resulted in 8 per cent of the cases. Swelling occurred less frequently, namely in 67 per cent. No necrosis developed, nor pyrexia.

Healing time was a little longer, two to five days, probably because of the delay in formation of the clot. No allergic manifestations were observed. The healing response, although satisfactory, was not so good as in the cases of primary bleeding.

Summary

As previously mentioned, the cases discussed in this paper covered 80 per cent of a total of 100 cases studied. They covered all variations of the so-called average type of bleeding one encounters generally after extractions or other dental operations.

Oxidized cellulose, particularly in the form of cotton, was found to control bleeding quickly in a tooth socket. It formed a gelatinous mass, which in most instances became organized in several days or gradually disappeared. The sockets, however, generally gave an appearance of enlargement, but this actually was an expansion of the adjacent soft tissues.

It seems that the cellulose has a marked tendency to expansion after its absorption of blood or lymph. This, coupled with the fact that the region becomes engorged with blood, helps create the expansion and extrusion of the clot, with its resultant breakdown at times.

Because of this breakdown, topical pressure in the form of a modelling compound splint was applied in several cases to control the expansion of the cellulose. Apparently this procedure is advantageous, for it reduced the marked swelling, and healing was hastened.

In a number of instances ecchymosis was noticed around the adjacent tissues. Evidently there was some tissue reaction in these cases, or the discoloration was caused by infiltration of blood into the tissues as a result of the engorgement. Systemic reactions were noted in one case only, and probably were caused by the extraction itself. After the first stage of engorgement of the socket, healing as a rule followed quickly.

Conclusions

Oxidized cellulose, a satisfactory and practically nonirritating foreign material, was tested for the control of hemorrhage occurring after dental operations. Up to the present, it has been found to be the best of the various agents available for this purpose.

It is simple to use, immediately ready and inexpensive.

The tissue reaction is negligible. Its one disadvantage is the localized swelling that frequently follows its use.—*630 West One Hundred Sixty-Eighth Street.*

ANKYLOSIS
OF THE TEMPOROMANDIBULAR JOINT

Douglas B. Parker, M.D., D.D.S.,
New York

ANKYLOSIS involving the temporomandibular joint is one of the lesions that oral surgeons are likely to encounter in their practice. Ankylosis has been defined as abnormal immobility and consolidation of a joint. Several conditions are characterized as ankylosis. One is intracapsular ankylosis in which there is a more or less complete bony union between the articular head of the condyle and the glenoid fossa of the temporal bone. This is the ordinary true ankylosis usually encountered in practice. Another type, rarely encountered, is the bony or dense fibrous union of the coronoid process of the mandible with the zygoma or the temporal bone. This type of union results in immobility of the temporomandibular joint even though no local pathologic condition exists in the joint itself. Such a vicious union as this extracapsular ankylosis can result only from a lateral traumatic injury involving the zygoma, the coronoid process or the temporal bone, or from infection. The third type of ankylosis, which is not a true ankylosis involving bony union, is the so-called false ankylosis which results from the contraction or cicatrization of the muscles or ligaments about the joint and capsule or the elevator muscles of the mandible.

The temporomandibular joint is a ginglymo-arthrodial joint which has a normal hinged motion with a slight forward excursion of the condylar head towards the articular eminence when the mouth is opened, plus a slight lateral motion of rotation during the act of mastication. The articular surface of the condylar head is separated normally from the temporal bone by the interposition of an articular fibrocartilage or meniscus and a synovial sac. The joint is surrounded by a capsule and a capsular ligament which normally influences the excursion of the condylar head during the acts of mastication and talking and other normal movements of the mandible. The normal excursion of the condyle follows a definite path which varies only with the habits of the person and differences in anatomic formation of the glenoid cavity and the articular eminence.

Causes

Ankylosis of the temporomandibular joint occurs more frequently in children than in adults, usually in children under seven years of age. Usually the cause is associated with an acute inflammatory condition of the joint region, which may be the result of traumatic injury from a fall or a blow sustained on the symphysis of the mandible, or from an acute infection in a region contiguous to the joint itself. Not infrequently, the patient with ankylosis will show a scar on the point of the chin which is visible on careful examination. An infant falling out of a crib will often sustain an injury which will result in ankylosis some time later. A middle ear or mastoid infection will extend through the tympanic plate and involve the joint at times (Fig. 1, left). In the examination of patients with ankylosis not involving trauma, we always look for a mastoidectomy scar in trying to determine the cause of the condition. Often extensive osteomyelitis of the mandible will result in cicatricial

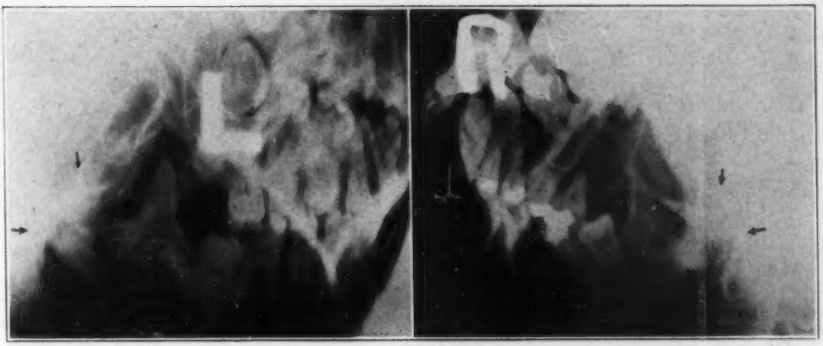

Fig. 1.—Left: Ankylosis of temporomandibular joint with productive calcification after acute mastoid infection. Right: Ankylosis of right temporomandibular joint in case of bilateral rheumatoid arthritis

deformities of the elevator muscles which restrict the movement about the joint and may so immobilize the joint that osteogenetic changes may result in ankylosis. Some of the acute exanthematous diseases of childhood may be etiologic factors of ankylosis. Some cases of gonorrheal arthritis have affected the temporomandibular joint with resultant ankylosis. Rheumatoid arthritis is another disease which may involve the joint and eventually result in ossification of the region (Fig. 1, right). Such cases present the most difficult problem of treatment that is encountered, because the condition is usually bilateral and the patient's physical condition is poor.

Extent of Involvement

About 80 per cent of the patients with ankylosis of the temporomandibular joint have fixation of the joint on only one side of the mandible. It is often difficult to ascertain definitely before operation if only one joint is involved. This is especially true if the condition has existed for many years, during which time the unaffected side has been unable to function because of the solid bony fixation of the affected joint.

Good roentgenograms of the joint regions of both sides are essential in making the diagnostic study of ankylosis. Further pictures taken in the Waters sinus position will often aid in diagnosis. The typical roentgenogram shows a large, dense, massive region of calcification in the position normally occupied by the head of the condyle and the joint space. The region of calcification is often quite extensive and will obliterate all anatomic landmarks in the joint region. The calcification may be extensive enough to obliterate the sigmoid notch and the coronoid process. Ankylosis occurring in childhood, or of long duration, will show a typical picture of a downward hypertrophy of the angle of the mandible and an accentuation and a typical foreshortening of the body of the mandible in its horizontal axis, which gives the characteristic appearance of the receding chin humorously referred to as "Andy Gump" chin (Fig. 2, left). The reason for the prominence of the angle of the mandible cannot be explained by the overdevelopment caused by the effort to open the mouth, because none of the depressor muscles is attached at the angle of the mandible (Fig. 2, right).

Complete Fixation

In cases in which there is complete bony ankylosis on only one side (Fig. 3) muscular efforts on the part of the patient to open the jaw will often elicit a slight movement of the mandible which can be explained only by the possibility of some slight movement of the whole temporal bone on the affected side. In cases in which this does occur, some movement can be felt over the head of the condyle on the unaffected side when it is palpated by the index finger with pressure under the zygoma.

Most patients in whom ankylosis of the temporomandibular joint develops from trauma give a history of a gradual limitation of motion over a period of a few months to a year before fixation of the joint is complete. In the early stages of the disease joint movements may be painful, and because of this the patient automatically limits his use of the joint.

If complete bony ankylosis has taken place the patient is often unable to practice mouth hygiene adequately, which results in rather extensive dental caries if the inability to open the mouth has persisted for some time. Repair of much of this carious condition is limited by the inaccessibility of many of the carious regions so that many of these patients suffer from the pain of unchecked dental caries. This condition also makes it highly difficult to extract some of the hopelessly involved teeth in the posterior part of the mouth.

Prevention

The question is frequently asked as to what could have been done to prevent ankylosis of the temporomandibular joint from occurring. In cases in which trau-

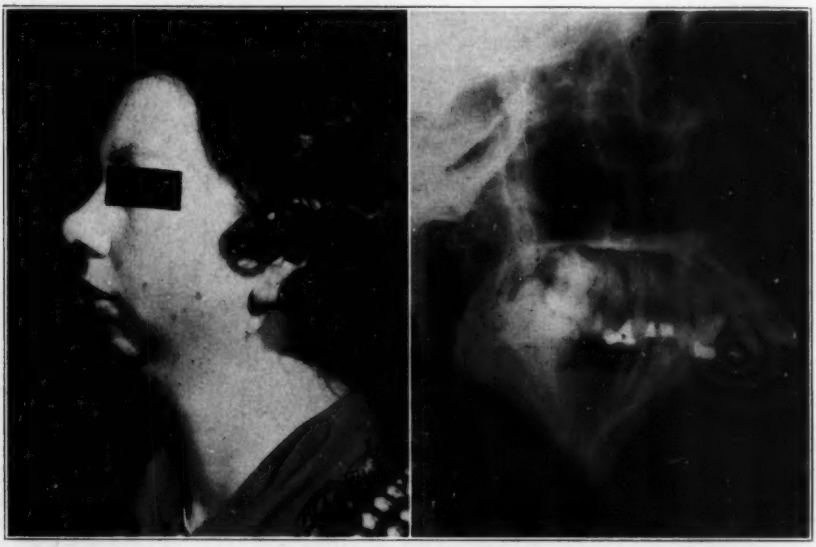

Fig. 2.—Left: Typical underdeveloped chin of patient who had ankylosis in childhood. Right: Roentgenographic study of typical deformity of receding chin with prominent growth at the angle, resulting from ankylosis after infection of ramus

Fig. 3.—Asymmetrical deformity of mandible after ankylosis of right temporomandibular joint

matic injuries have caused an anteroposterior force to be exerted backward from the symphysis of the mandible toward the condylar heads, an injury to the meniscus or the tympanic plate of the temporal bone may result. Otherwise, fracture of the neck of the mandibular condyle may occur. In such cases opening the bite of the posterior teeth by the interposition of some substance between these posterior teeth when immobilizing the mandible will take much of the pressure off the joint surfaces, or, in fractures, will help prevent some of the telescoping effect of the long axis of the ramus in the vertical dimension. In cases involving injury about the condyles, long-standing immobilization of the jaw is contraindicated. Some gradual motion of the condylar surfaces should be permitted after three weeks of immobilization. Such early motion will often avoid fixation of a joint, which may result in ankylosis. After four or five weeks the patient is encouraged to chew gum but to avoid chewing anything which requires masticatory stress. In cases of polyarthritis, which involves the temporomandibular joints, early systemic arthritic treatment should be instituted. The early treatment of gonorrheal infections by the use of penicillin will often prevent arthritic lesions which may result in ankylosis.

Surgical Treatment

The treatment of true bony ankylosis of the temporomandibular joint is entirely surgical. Many different technics for arthroplasty, devised by various surgeons, have been more or less successful, depending on the surgical principles involved. The first consideration is the accurate determination of whether the joints of one or both sides of the mandible are involved (Fig. 4). If a single joint is involved, a single stage operation should suffice. If both sides are involved, I feel that it is better judgment to operate on only one side at a time, rather than attempt to free both joints

Fig. 4.—Dense, massive area of consolidation about condyle of patient who fell on chin when three years of age

during the same operation, because there is a much greater probability of failure if both sides are involved and are operated on at the same time. The elevator muscles working from both sides tend to pull the ramus upward on both sides, foreshortening the length of the ramus, which frequently results in an open bite and recession of the chin or in the eventual recalcification of the region of the joint. If only one side is operated on at a time, in a case of bilateral ankylosis, the ankylosed opposite joint holds the mandible fixed during the healing of the side operated on so that connective tissue can fill in and interpose a cushion between the mandible and the temporal bone. Six to eight weeks later the second side can be operated on, and active motion of both joint regions can be stimulated.

Technic

The technic of temporomandibular arthroplasty which I have found to give the most satisfactory functional results if true bony ankylosis exists between the head of the condyle and the fossa in the temporal bone is as follows: An inverted L-shaped incision is made through the skin and fascia in the preauricular region. The hair in front of and above the ear has been previously shaved off to give a clean field. The horizontal incision is made over the lower border of the zygoma and carried forward from the lobe of the ear about 3 cm. in length. A vertical incision is carried downward about 2½ cm. from the posterior end of the horizontal incision. The horizontal incision is carried to the outer portion of the ankylosed mass of hypertrophied bone. The vertical incision is carried through the skin and superficial fascia, and the deeper structures are separated vertically by blunt dissection or by hemo-

stat separation so as to avoid the facial nerve. Deep retraction by strong metal retractors is essential for proper exposure of the region. The technic for removal or separation of bone is for the operator to choose. I favor use of a mallet and chisel. I prefer to use a sharp, narrow chisel and cut a groove horizontally along a line determined as the lower border of the mass of bone to be removed. I prefer to plan on removing a section of bone between the mandible and the temporal bone about 2 cm. in the vertical diameter. As a rule, this lower cut is about the height of the sigmoid notch. When the cut approaches the inner side of the ramus of the mandible care must be taken that the chisel does not cut through deeply and sever the internal maxillary vessels. Hemorrhage from these vessels is difficult to control except by firm packing. After the lower cut through the mandible has been completed the lower jaw should be movable (Fig. 5). This can be determined by the anesthetist or by an extra assistant who is not otherwise helping in the operation. The upper segment of bone to be removed is separated by broader chisels than those previously employed, used horizontally. The use of rongeur bone-cutting forceps may hasten removal of bone from some of the region, especially if there are sharp margins of bone which might be an irritating factor if left in position.

In cases in which particularly extensive bony hypertrophy involves the space between the arch of the zygoma and the temporal bone, there may be calcification involving the coronoid process. If this occurs it may be necessary to remove the entire coronoid as well as the condyloid portions of the mandible (Fig. 6).

I have found it essential to remove a fairly large section of bone so that there is

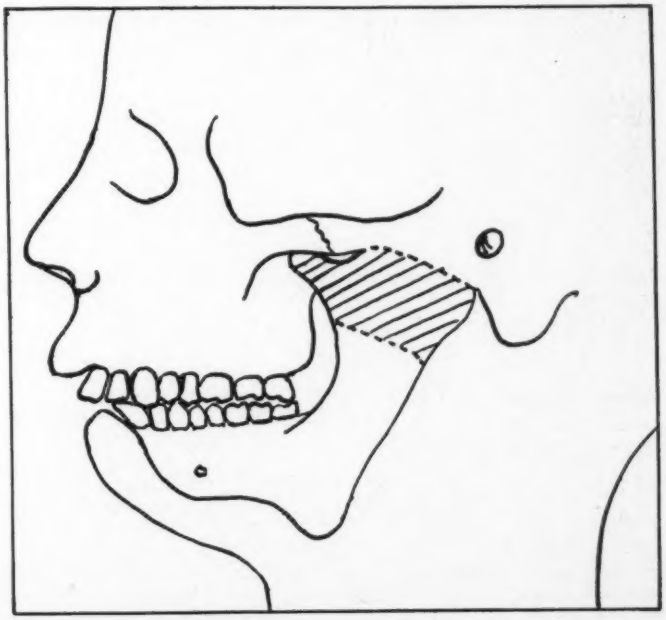

Fig. 5.—Shaded section of ramus was removed by operation

a space of at least 1½ cm. between the upper cut portion of the ramus and the temporal bone. Great care should be observed that all loose bone chips are removed from the region of the wound, because these may be a source from which new bone cells may develop, resulting in eventual operative failure if sufficient recalcification takes place.

Many surgeons cut only the mandible free from its temporal fixation and then interpose some fascia between the cut surfaces. This method has resulted in a fairly large percentage of failures, apparently because the small space between the cut surfaces of bone compresses the interposing fascial strip and causes absorption and eventual reunion of the bones by contact.

A procedure which I have found particularly successful is the packing of the entire space from which the bone has been removed with half inch iodoform gauze, one end of which protrudes from the lower pole of the vertical incision. The deep fascia and muscles are sutured with absorbable gut sutures and the skin and superficial fascia are sutured with interrupted dermal silk, leaving only enough space to remove the iodoform gauze, which also acts as a dependent drain.

Bite Block

The next step in the operation is the use of a rubber bite block between the posterior teeth on the side operated on. This bite block is wired to the posterior teeth so that the mouth is in an open bite position. This position is not particularly com-

Fig. 6.—Roentgenographic appearance after resection of ramus

fortable for the patient, but if the lips are kept moist with creams or ointments the block can be tolerated for the six or seven days that it is left in place. The advantage of this open bite position is that it maintains the open space between the cut ends of the bones and puts the elevator muscles in a stretched position during the early healing period, so that there is a minimum of contraction along their long axis, thereby tending to reduce muscular trismus.

Control of Hemorrhage

The iodoform gauze packed in the operative space aids in controlling the sometimes troublesome venous hemorrhage, but its importance is in stimulating granulation in the dead space as well as in interposing a medium of separation between the bones during the period of granulation. The gauze is removed gradually over a period of about three weeks. A small strip is cut off every other day, starting about the sixth day. This allows a gradual elimination of the dead space by granulation about the periphery of the gauze packing. J. M. Hickey[1] has recently tried cellular cotton, or Oxycel, packed into the dead space and has closed the skin wound completely. This cellular cotton apparently controlled the bleeding without the use of dependent drainage, and the wound healed well. The time elapsed since operation is too short for any statement to be made about the eventual outcome of this technic, but after four months the mandible is functioning well. Lottes and Frantz[2] suggested the utilization of oxidized cellulose in arthroplasty procedures in that it interferes considerably with the repair of bone.

After the bite block is removed the patient should be encouraged to move the mandible as much as possible. The chewing of gum is one way to stimulate this movement on the part of the patient. If there is a history of long-standing chronic infection in the soft tissue overlying the joint as the original etiologic factor in the ankylosis, functional use of the mandible may be delayed after operation. This may necessitate use of gradual stretching and spring exercises to achieve the maximum functional result.

The operative technic described has been used by H. S. Dunning and myself in a large series of cases of ankylosis varying in their duration from eighteen months to thirty-four years. The results have been uniformly good as to both functional and esthetic results. The only failures have been in cases of bilateral ankylosis in which systemic rheumatoid arthritis was the causative factor in the joints' fixation. In some of these cases bone proliferation continued after the original arthroplasty had been performed, with the result that function was inhibited. The use of penicillin prophylactically has probably contributed to better healing of wounds and a smaller incidence of postoperative infection.

Maxillofacial Problems

The question of deformity in the contour of the face was mentioned earlier. In cases in which the ankylosis occurred in childhood prior to the complete development of the mandible, the mandible is either underdeveloped in its horizontal plane or there is an underdevelopment on one side of the face. The correction of either of these deformities is a maxillofacial problem. In the underdeveloped chin, either a cancellous bone or a cartilage graft to the symphysis will restore the prominence of the chin. The lateral contour of the flattened side of the mandible can be

1. Personal communication.
2. Lottes, Raphaele and Frantz, Virginia, Absorbable Gauze in Bone Surgery. *Ann Surg.* 124:28 (July) 1946.

improved by implantation of a rib cartilage graft along the lateral wall of the body of the ramus, extending anteriorly nearly to the symphysis.

The restoration of function to one handicapped by ankylosis has been highly gratifying to both the patient and the surgeon and contributes to the improved health of the patient through improved mastication and better oral hygiene. The plastic procedure of building out facial contour in patients deformed by early ankylosis has done much to restore the morale of the patient and eliminate the self-consciousness connected with facial deformity.—*121 East Sixtieth Street.*

ORAL SURGERY, ORAL MEDICINE AND ORAL PATHOLOGY

The first issue of *Oral Surgery, Oral Medicine and Oral Pathology* has been awaited with interest and fulfills the expectations of oral surgeons as an important contribution to the field of oral surgery, oral medicine and oral and dental pathology. Under the guidance of its distinguished editor, Kurt H. Thoma, and his well-qualified associates on the editorial staff, this outgrowth of the Oral Surgery section of the *American Journal of Orthodontics and Oral Surgery* will assume a position of eminence and great usefulness in dental journalism.

The inaugural issue is replete with valuable articles and case reports, and the quarterly review of the literature is a valuable addition to an outstanding journal. —*C. W. Waldron.*

NATIONAL BLOOD PROGRAM

The American Red Cross has announced the new National Blood Program, an undertaking designed to provide sufficient whole blood and blood derivatives for medical use throughout the entire nation without charge for the products.

The new peacetime project has been approved in principle by the major health organizations of the country. The various phases of the program, which will conform to standards set by leading authorities, consist of (1) collection of blood, (2) its processing for use as whole blood and blood derivatives, including packing and storage, (3) distribution of the blood and blood products for use by physicians and hospitals for any patients needing them and (4) continuous investigation of the quality of the products, their safety and important uses. It is estimated that the program, which will be financed by the Red Cross, will be in full operation in three to five years.

In addition to whole blood and plasma, the program will provide other blood derivatives of proved value, such as (1) serum albumin, (2) immune serum globulin, (3) antihemophilic globulin, (4) blood grouping serum, (5) fibrin films and thrombin, (6) red cell suspensions and (7) red cell paste and powder.

The Red Cross National Blood Program needs the continuing support and active cooperation of all the American people.

MAXILLARY ANTRUM COMPLICATIONS IN EXODONTIA

Bernard G. Wakefield, D.D.S.,
Buffalo

DENTAL complications involving the maxillary antrum have presented problems infrequently discussed. A summary of the principles and routines that have proved satisfactory in our hands for many years is presented.

There are oral surgeons who never extract upper bicuspids or molars; others are occasionally confronted by an antral involvement. Unfortunately, however, a third group is comprised of those who, through lack of training or dexterity or both, enter repeatedly into the antral cavity by accident and are completely unable to cope with the situation. It is by the last mentioned group that most of the troublesome cases are referred. No discredit is due the careful, trained operator who occasionally involves an antral cavity and then handles the situation properly thereafter. On the other hand, much discredit is due the surgeon who operates in this or any other region without being able to handle properly the attendant complications and the post-operative sequelae.

The Antral Cavity

A lengthy description of the anatomy is unnecessary, but a few statements of fact are in order, for they are to be the basis of my reasoning.

The antral cavity is lined with secretory ciliated columnar epithelium, whose general ciliate motion is toward the normal ostium high on the nasal wall opening into the middle meatus of the nose (Fig. 1). This ciliate action is largely responsible for the evacuation of normal antral secretions and foreign materials.

Any antrum without proper ventilation by way of the ostium cannot remain permanently in a healthy condition.

Antral cavities vary greatly in size, shape and contour, in different individuals, and may vary between right and left on the same individual.

Partial partitions and bone spurs are not uncommon to the inner walls (Fig. 2).

The lowest portion of the antral floor is normally in the first molar area; therefore, this is the weakest portion of the alveolus.

The maxillary sinus has very little resistance to oral bacteria.

Recurrent antral inflammation over a period of time may result in a thickening of the wall.

Any surgery is contraindicated in the case of a so-called "hot" antrum, one acutely inflamed in the early stages before the patient has built up any resistance.

Puncture of the Antral Floor

In considering the various complications, let us start with the most simple. If, during instrumentation, an instrument such as an apex elevator or small curette has punctured the floor of the antrum, very little is required. That little, however, is

Read at the twenty-ninth annual meeting of the American Society of Oral Surgeons, Boston, July 31-August 2, 1947.

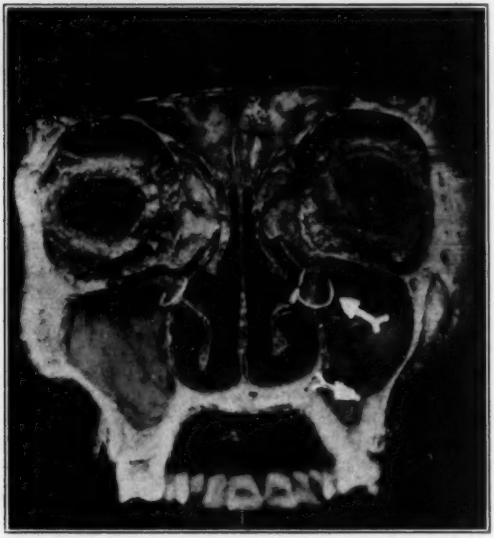

Fig. 1.—Ring in osteum. Roots occupy alveolus and encroach on antral cavity

important. The puncture should not be explored needlessly, to destroy the delicate membrane that will do so much, together with the blood clot, to seal over the opening and repair the defect. Punctures made with a curette will be less common if the operator always uses the largest curette that can be managed properly in the alveolus, because the same pressure on a large curette would be tolerated without producing a puncture that might occur if it were applied to a small curette. The marginal alveolar bone, especially on the buccal side, should be trimmed and smoothed in order to allow the mucoperiosteal flaps more nearly to approximate when sutured. This forms somewhat of a hammock for the clot to protect it and also places more tissue in apposition with the clot to aid in nourishing the latter. Before suturing, a light dusting of sulfathiazole powder should be applied, preferably with a blower. The patient should close on a small compress placed over the alveolus, until a clot has formed. This prevents oral contamination and the formation of an excessively low, bulbous clot. If the latter is allowed to form, it is likely to be disturbed later by the tongue, with the possibility of starting postoperative hemorrhage and allowing sepsis to enter at the margins. In fact, this precaution is applicable to any extraction socket.

Remembering the discussions in past years, many of you listening will be ready to disagree with the suggestion of the use of sulfathiazole powder. Since it has been found extremely helpful in our hands, it is included. The sulfathiazole powder, in an extremely light dusting, seems not only, through its bacteriostatic action, to preserve the clot from early sepsis, thus giving the wall a chance to repair, but also reduces postoperative soreness and the tendency to bleed.

The patient should be instructed to avoid rinsing, blowing the nose, smoking or any sucking action, for at least twenty-four hours. The tissues of the oral cavity

seem to repair faster and with less marginal inflammation if smoking is avoided or at least minimized, especially in the case of cigarettes. The sutures should be left for at least forty-eight hours.

Closure of the Antral Cavity

Next, let us suppose that either as a result of pathology, adhering bone, or accident, a frank opening exists by way of the alveolus into the antrum. This deserves a complete closure, if trouble is to be avoided, and during closure every effort should be made to avoid carrying oral sepsis into the antral cavity and beneath the mucoperiosteal flaps. The type of flap is, of course, the operator's choice, as conditions warrant at the time. However, one method may make it easier to cause approximation of the buccal and palatal flaps and to save turning many palatal flaps. The buccal mucoperiosteal flap cannot be stretched appreciably, and if it is attempted with the sutures, they are sure to slough their way out promptly. This is due to the tough, unyielding character of the periosteum. That being the case, with a generous buccal flap elevated, simply slide underneath, preferably with a curved blade scalpel, and sever only the periosteum. This allows the flap to be carried quite a distance without tension on the sutures and closes many openings that would otherwise require complicated flaps. Here also, sulfathiazole powder seems to be helpful. The sutures should be cut reasonably short to avoid disturbance by the tongue and should be removed in three to four days. The patient should be warned against any rinsing or blowing of the nose for a few days. If the nose must be blown, the handkerchief should be held well away to avoid closing of one nostril which would create air pressure on the other side. An astringent nasal spray should be given, such as ephedrine with merthiolate, to be used four times daily for one week, to maintain proper ventilation and thus avoid antral pressure building up within and to prevent its tendency to force the flaps apart. The patient will be less alarmed if informed that bloody nasal discharge can be expected for a few days. Of course, this is due to the flap closure preventing the normal exit of blood from the alveolus. It is desirable to arrange for a checkup two weeks or so postoperatively, to be sure of a successful closure and a clean antrum.

Removal of a Root from the Antrum

Where a root portion has found its way into the antrum, immediate recovery is desirable before an inflammatory sinus is reached. There seems to be far too great a difference in opinion regarding the method of its recovery. All too often the operator attempts to remove the root by the path of least resistance, through the alveolus, only to wind up with a large opening at the lowest point of the antral floor, and even then, possibly, not to recover the root itself. Such an opening might be compared to an opening through a ceiling to locate an object on the floor above; through such an opening one would see only a small portion of the ceiling of the next room. Such an opening at the lowest portion of the antral floor invites drainage of the antral secretions with the risk of an antro-oral fistula. Where successful, such an approach requires an opening much larger than the foreign body in order to accommodate the root, plus the instrument. When unsuccessful in recovering it by instrumentation in this manner, the operator is likely to make a second and even greater mistake by attempting to irrigate it out of the antral cavity. Even in those cases where the root is successfully recovered by irrigation, a difficult job of closure remains. The closure is made still more difficult by the irrigation, since the latter, in addition to spreading over the entire wall of the antrum any sepsis present, also bogs down the

cilia of the lining membrane for several hours, thus preventing its normal behavior in evacuating the sinus of blood which in turn invites further sepsis.

Since an opening, even a large one, made through the buccal wall similar to that used in a radical antrum, presents no problem in closure it seems the logical approach. Through such an opening we have vision and room for instrumentation to recover the root. There is no tendency for secretions to drain through this area, and it can be accomplished with reasonable surgical deftness and cleanliness.

If the root enters the antrum during a single tooth extraction, it is best to close the socket immediately as previously described and to make a fresh horizontal incision in the mucobuccal fold above the bicuspid and first molar region to gain proper access to the antral cavity. However, if the accident occurs during a complete extraction of that quarter of the mouth, then the entire buccal flap may be retracted sufficiently to give access to the area of approach and to avoid the incision buccally. When the horizontal buccal incision is used, it is closed with one or two sutures. If the entire flap is lifted, a closure will be found easier in many instances, if the periosteum is severed as previously mentioned. However, all blood should be aspirated just before sutures are placed, but never irrigate. A very light dusting of sulfathiazole powder can be used here also. Following such a procedure, the patient should follow the same postoperative routine outlined in the preceding case, plus the use of an ice pack on the cheek immediately postoperatively for the first two or three hours. This will tend to lessen the amount of postoperative swelling and also the amount of blood likely to be deposited in the antral cavity.

In cases where a referring dentist calls, in behalf of a patient on whom he has just had the misfortune to push a root into the antrum, make every effort to see the patient at once. If I am to see the patient at once, I request him to close on a compress in the meantime, thus avoiding unnecessary contamination of the antral cavity especially through rinsing. However, there are many cases where neither the patient nor the surgeon is able to devote the necessary time to complete the work immediately. When such a delay is inevitable, the dentist should be requested to remove carefully all pathologic material from the alveolus and trim the marginal bone. He then should use the sulfathiazole sparingly and suture the wound as though completed. The patient should be requested to avoid rinsing the mouth, blowing the nose, and preferably should use the vasoconstrictor spray four times daily in the nose, until he can be examined. There is a good chance that the alveolar opening will close normally. Following such a procedure, the root will be removed by way of a new incision in the mucobuccal fold, and a new antral opening through the lateral wall above the bicuspid and first molar region (Fig. 2). The instrument of choice for removing the root should be either a loop-type curette or a small curved aspirator tip, with no side openings but just the opening at the end, which makes it possible to pick up a foreign body such as a root and remove it.

Chronic Antro-Oral Fistula

The next consideration will be that of the chronic antro-oral fistula, so often presented for closure. Although usually assured that the antrum is free and clear, the operator often finds small pieces of root, gauze dressing and even particles of chewing gum. One patient readily explained that a piece of gum at mealtime kept fluids from passing through to the nose, but that she supposed each wad of gum came out of the socket instead of passing up into the sinus.

These cases, if of long duration, are usually complicated. There is usually a polypoid degeneration of the antral lining in the lower third or half of the antrum, and

Fig. 2.—Partial partition, showing location of nasal window and location of buccal approach to antrum

the ostium is seldom open enough for good ventilation. This type of case requires consideration, for the one with a normal, open ostium and clean walls requires only the usual flap operation.

If the ostium is closed, any flap operation is quite sure to fail because the antrum will build up pressure and recreate the oral fistula, unless an antronasal window is made either at the time of, or prior to, closure. If the operator is trained to do so, it seems desirable, especially from the patient's standpoint, to make the window and complete the closure at one operation. If not, it is better to refer the patient to an otolaryngologist for the nasal window, and then to wait about one month before completing the closure. During this period of time, the antral membrane and any polyps present tend to shrink, and the latter tend to disappear. In a great many cases, in fact, this ventilation alone results in the antro-oral fistula closing by itself. That is easy to understand when one recalls that, had there been proper ventilation in the first place, probably there would have been no fistula.

To determine prior to operation whether the ostium is open, first close the patient's nostrils and request him to blow the nose. If air comes freely through the fistula, it indicates a normal ostium and probably a clean antrum. However, if no air comes through, instead of a closed ostium, it may mean only that a polyp is lying over the fistula and acting as a valve. Insert a large aspirating needle or syringe tip far up through the opening, and again close the nose while the patient blows. If no air comes through now, one can feel sure that the antrum is not ventilated and a window is required.

Operative Procedure

It is unnecessary to trace the routine steps of the operation. However, a few points should be emphasized. The fistula itself is usually an epithelized tract and, there-

fore, will not tend to heal unless excised, leaving fresh margins. In cleansing out the antral cavity, previously it was considered necessary to rid the sinus of its entire thickened membrane as well as the polyps. However, that seems unwise, for seldom more than the lower half is polypoid in character. Therefore, remove the polypoid tissue only. The window is made by inserting a rasp from the nasal approach, into the antral cavity, and this opening is enlarged with an antral rongeur. In doing so, one must be sure to excise not only the bony wall but also the membrane on either side to avoid an early closure of the window. This window also should be of a generous size and well down toward the floor of the nose, at the anterior portion of the antrum beneath the inferior turbinate bone (Fig. 2). After the antrum is cleaned out thoroughly and the window made, half inch iodoform gauze is then carried through the antral cavity and out through the nasal window, so that about 18 inches of gauze hangs out of the anterior naris. The gauze is packed back and forth, starting at the nasal window, until the entire antral cavity has been filled. The loose end is packed back into the anterior naris, completely sealing it off until the removal of the gauze on the following day. The gauze serves several purposes: It prevents an antrum from filling with blood to be drained out later; it reduces the likelihood of postoperative hemorrhage and is antiseptic in character; and it also prevents the patient from carelessly disturbing the flaps during the early period by blowing and similar actions. When the gauze is removed on the following day by way of the naris, the patient's head is kept tilted down over a basin until bleeding has ceased, in order not to cause the blood from the margins of the window to run back and fill the sinus. No irrigating is done at this time, in fact, none until the oral incisions are healed, and then only if indicated by nasal discharge. At least one suture should be a mattress retaining suture, and all sutures should be left four or five days.

Acutely Inflamed Sinus

The next, and one of the most important, considerations is that of an acutely inflamed so-called "hot" sinus. Many times I am prevailed upon to perform surgery, either at the patient's insistence or that of his physician or dentist, to relieve suffering. Sometimes it is a case resulting from a dental extraction, at other times a case where an acutely inflamed sinus will not respond. In desperation the physician wants an extraction. Surgery, under such conditions, not only is extremely hazardous but seldom will accomplish the desired result. However, if it is a case where the acute sinus has an oral communication, it can be irrigated successfully through the fistula and is the proper procedure to follow, for not only is it easier but safer than making nasal punctures under these conditions. It will be found also that, where an antral operation is to be performed, the recovery will be improved greatly if all periodontal sepsis is under control first. It should be kept in mind, however, that while the oxygenating mouthwashes may be helpful in clearing up the periodontal disease preoperatively, they should not be used for a few days postoperatively, for there is a tendency to irritate the fresh tissue margins and destroy blood clots.

Fracture of Tuberosity and Antral Floor

Still another serious accident is the fracture of the tuberosity and antral floor as a unit during extraction. It is, in nearly every case, the result of injudicious forceps pressure, rather than following a surgical technique for the removal of a difficult upper posterior tooth. Also, it may happen from even ordinary forceps pressure if the first molar is extracted prior to the second or third. In such cases, the removal

of the first molar, whose roots occupy so much of the bulk of the buccal and palatal processes, weakens that area severely (Figs. 1 and 3). Then, when pressure is applied on a firm second or third molar, the fracture occurs. Such an accident can occur, also, in cases of a firm second or third molar standing alone with a low dipping antrum in the first molar area. Normal precautions, however, will prevent nearly all such occurrences. One should always extract the back molar first and work forward. Also, for molars in this area standing alone, either buccal flaps should be made or a straight gouge should be used about the entire gingival circumference before applying forceps pressure. This is especially true where, by roentgenographic evidence, a very low dip can be determined in the antral floor anterior to the tooth in question.

Let us assume now that a case is at hand with such a fracture of the tuberosity and antral floor. If the dentist would stop his extraction efforts before everything was hopelessly ruined, much could be done to save the day. The loss of a tuberosity and antral floor is a serious matter even if it heals uneventfully, for the tuberosity is an important factor in the retention of dentures. When it is dissected, no ridge will be left, but only a tapering off of the alveolus up to the postmalar pocket. This is a real prosthodontic problem. Therefore, it seems good judgment to make every effort to save this bone. Where it is only fractured but not dislodged, and where no opposing tooth is present, it seems wise to allow complete healing and then to attempt a surgical removal. However, where the tissue is lacerated and the segment is badly loosened, immediate removal of the tooth is indicated. In doing so, it is possible to grasp the tooth firmly in a molar forceps and, with a thin, sharp, straight gouge, force the bone away from the tooth, holding the latter still and in position with the forceps. Occasionally, dissection of the entire fractured area is required, but this

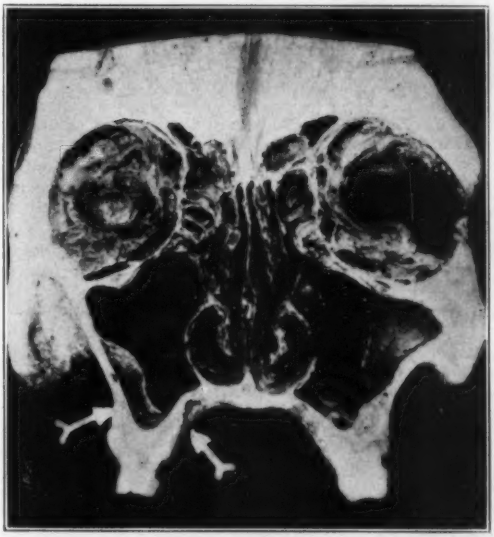

Fig. 3.—First molar makes up greater part of antral wall in many cases

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should be avoided wherever possible. Even in those cases where the bone seems quite fragmentary, as much as possible should be left. By well placed sutures, the badly traumatized tuberosity, with some loss of bone, can be retained in position slightly forward to its original, and thus a fairly firm denture support can be secured.

Third Molar Extraction

Still another less common but perennial accident is that of an impacted upper third molar which, during its removal, is forced into the antrum. While it is true this is usually the result of an inexperienced operator, it can happen to anyone. When such a case is presented, the original flap should be closed after making sure no part of the dental follicle or debris remains in that area. An incision above the second bicuspid and first molar area is made to allow entrance through the wall, remaining well above the roots of those teeth. The tooth can be removed with the least amount of damage and in a much more surgically clean and surgically accurate manner than to attempt removal through its original point of entry. The patient should be instructed not to blow his nose or rinse his mouth for at least twenty-four hours. Early cold packs to the cheek are helpful, and a vasoconstrictor spray, to be used four times daily, is essential.

When, following an unfortunate third molar extraction, an open fistula results, it is sometimes very difficult to manage flaps in this area. Sloughing here is also a problem. One helpful method is as follows: Either with a rongeur or chisel, some of the buccal bone and the bone beneath the fibrous tuberosity should be removed. This will allow it to be pulled forward to approximate the second molar. Then a deep heavy suture should be placed through the fibrous tissue of the tuberosity and through the interproximal space anterior to the second molar. The second molar affords good anchorage, and a suture deeply placed in the tuberosity tissue does not slough readily, thus allowing the tuberosity to be held forward until the alveolus is well on its way toward healing. Such a suture may be left for at least four or five days.

Another procedure that may prove helpful is as follows: After a palatal flap has been turned and carried over to close an antro-oral fistula, there remains a triangular defect on the palatal aspect. This defect is apt to be very sore, sometimes takes on infection and always bothers the patient when eating. It can be overcome by the use of a dressing made of surgical pyorrhea pack, with cotton incorporated. This mass of proper size can be molded and held until firm, causing it to fit sufficiently beneath the undercut of the flap margins to retain it in position. The pack will not only protect the tissue margins but will also take the tension off our deep retaining mattress sutures, to a very large extent, and when removed in a week or more will leave a clean, granulated surface which will heal and fill in quite readily.

Conclusion

The maxillary antrum represents a field of responsibility divided between the oral surgeon and the otolaryngologist. When responsibility is thus divided, cooperation between the two parties is most essential for the patient's best interest. It is important, therefore, for us to convey fully our reasons for asking that a window be made or for refusing a certain extraction. It is of equal importance, however, that we try to see his problems, for many a chronic antral infection will remain chronic in spite of excellent treatment if an infected molar tooth is allowed to remain in that region.

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Last, but not least, a diagnosis of antral infection should never be attempted or claimed from dental roentgenographic evidence alone. It requires a good anterior-posterior plate, in the hands of a competent roentgenologist, with the exception of the occasional extreme case.—*333 Linwood Avenue.*

QUERIES AND ANSWERS

Questions appearing in this department are asked by subscribers to the **Journal of Oral Surgery** and are answered by one or more members of the editorial staff. Signed and unsigned questions are given equal consideration. Questions are published with the inquirer's initials only. Address questions to

Queries and Answers
The Editor, Journal of Oral Surgery
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Query: In making injections around a tooth may one use the same needle for two insertions or should a fresh needle be used for each insertion?—B. T.

Answer: Intra-oral use of local anesthetic agents presents problems ordinarily not encountered elsewhere. The preparation of the oral field, prior to needle insertion, cannot promise as much in the prevention of contamination of the needle as can sterilization of the skin. Nevertheless, the goal should be sterile needles and a field as sterile as can be achieved. If the field is dry and clean it would seem that there is no absolute need to change needles if infiltration is carried out in the anterior part of the mouth and if acute infection is absent. However, if any deep injection is to be made, such as that for inferior alveolar nerve block at the mandibular foramen, it would be well to employ a fresh sterile needle and insert it into a spot which has been thoroughly cleaned, dried and freed from saliva. Despite the greatest care, organisms are sometimes carried into the tissues by the needles.

AMERICAN BOARD OF ORAL SURGERY

Examinations for certification by the American Board of Oral Surgery will be held in Chicago on September 7 and 8, 1948.

Requests for application forms or additional information should be addressed to Dr. Leslie M. FitzGerald, Secretary, 718 Roshek Building, Dubuque, Iowa.

CYSTS AND FISTULAS OF THE BRANCHIAL AND THYROGLOSSAL DUCTS

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SWELLINGS and lumps in the mouth and submandibular regions are always of interest to the oral surgeon. The difficult problem of diagnosis requires a good working knowledge of embryology, anatomy and pathology. In view of the many possible lesions and the difficulty and danger of the operation, a study and review of these lesions is always of great value.

The terminology of the congenital lesions of the neck has been varied and confusing. The lesions have been called branchial cysts, congenital cysts of the neck, lateral cysts of the neck, lateral cervical cysts and sometimes vestigial cysts. Senn,[1] in 1884, stated that the terms used prior to his time were hydrocele colli congenita, dermoid cysts of the sheath of the internal jugular vein, hygroma colli and atheromatous cysts of the lymphatic glands. Today, the most common terms are either branchial cysts or lateral cervical cysts of the neck. Cysts and fistulas of the thyroglossal duct have always been known as such with no resulting confusion.

Embryology

Much study has been done on the embryologic considerations of these lesions. Among the many who have made contributions to this subject are Rabl,[2] Wenglowski,[3] Hyndman and Light,[4] and Meyer.[5] A recent and excellent short paper on embryologic considerations is that of Evert and Black.[6]

During the first two weeks of embryonic life five arches are formed in the neck of the embryo. These produce ridges separated by grooves which are found on the external lateral and ventral surfaces of the embryonic neck. By the sixth and seventh week there are four external grooves with four internal pouches lying opposite on the inside of the pharynx and an arch of supporting skeletal element on either side of each groove. The first two arches are much larger than the other three so as to overlap and obscure them. The second arch, which is the largest, becomes attached to the thoracic wall and thus a sinus is produced beneath, which becomes closed off; and, under normal conditions, the epithelial lining of this sinus is obliterated or absorbed. Sometimes, however, the epithelial lining persists and the embryonic cervical sinus or a part of it forms the cervical cysts of the adult. Likewise, a pinching off and nonabsorption of the entodermal lining of the pharyngeal pouches on the inside of the embryonic neck may produce internal cysts. Also, if the thin wall intervening

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1. Senn, N., On Branchial Cysts of the Neck. *J.A.M.A.* 3:197 (August) 1884.

2. Rabl, C., Zur Bildungsgeschicte des halses. *Prag. med. Wchnschr.* 11:497, 1886 and 12:3, 1887.

3. Wenglowski, R., Uber die Halsfisteln und cysten. *Arch. f. klin. Chir.* 98:151 (April) 1912 and 100:789 (January) 1913.

4. Hyndman, O. R. and Light, George, The Branchial Apparatus. Its Embryologic Origin and the Pathologic Changes to Which It Gives Rise with Presentation of a Familial Group of Fistulas. *Arch. Surg.* 19:410 (September) 1929.

5. Meyer, H. W., Congenital Cysts and Fistulae of the Neck. *Ann. Surg.* 95: (January) 1932 and 226 (February) 1932.

6. Evert, J. A. and Black, John A., Embryologic Considerations in Surgery of the Neck. *Proc. Staff Meet. Mayo Clin.* 22 No. 4 (February 19) 1947.

between the embryonic pouch internally and the groove externally breaks through, a cervical fistula results, opening directly from the pharynx to the outside.

The embryology of the cyst and fistula of the thryoglossal duct is also of interest. At about the third week, a rounded swelling or bud appears on the ventral side just behind the first arch. (Incidentally, according to Arey,[7] the upper and lower jaws and teeth are derived from the first arch.) The tuberculum impar along with two similar swellings appearing laterally form the anlage of the buccal part of the tongue. In the fourth week a diverticulum descends between the tuberculum impar and the copula and passes as a tubular duct (the thyroglossal duct) downward anteriorly to the trachea to form the pyramidal lobe of the thyroid gland. The point of descent remains as a depression, the cecal foramen, at the base of the adult tongue. This tubular duct normally atrophies and is obliterated but occasionally it remains, producing a cyst or fistula of the thyroglossal duct, or accessory thyroids, usually in the midline anywhere from the foramen caecum down to the pyramidal lobe of the thyroid gland.

Classifications

Andrews[8] has given us a workable classification of (1) cysts with no external or internal openings; (2) cysts and fistulas opening internally; (3) cysts and fistulas opening externally; and (4) fistulas with internal and external openings.

Bailey[9] classified the cysts and fistulas by position as superficial; deep; auricular; parotid; tracheal; submaxillary, and sublingual. Hyndman and Light[4] classified them as to origin, contents and type of lining epithelium. Likewise, it should not be forgotten that auricular and preauricular sinuses occur, as well as cervical tabs which often contain cartilage.

Pathology

There have been many theories as to the origin and development of these anomalies and there is no general agreement as to the cause. The various theories may be briefly outlined as (1) rupture of the embryonic membrane separating the branchial clefts; (2) failure of malformed clefts to unite properly; (3) incomplete regression of the branchial apparatus; (4) anomalous development of the vestigial remnants of the branchial clefts; (5) persistence of the cervical sinus; (6) remnants and/or persistence of the thymic duct, and (7) in case of the thyroglossal duct cyst or fistula, the failure of the duct to obliterate properly.

Cysts derived from the ectoderm contain squamous epithelium and a putty-like substance. Cysts from the entoderm contain columnar epithelium and mucoid material which sometimes contains cholesterol. Some cysts occasionally contain both kinds of epithelium. Cysts and fistulas of the thyroglossal duct usually are lined by squamous epithelium.

Clinical Considerations

The most important symptom or physical sign is that of a lump or swelling in the submandibular region and in the neck. The lump or swelling is almost always painless, of long duration and of slow development. The size may vary from that of a pea to that of a baseball. In many cases the fistula has been caused by incision of the

7. Arey, Leslie B., *Developmental Anatomy*. Philadelphia: W. B. Saunders Co., 1942.
8. Andrews, E. Wyllis, *Keens Surgery*, Vol. 3. Philadelphia: W. B. Saunders Co., 1911, p. 278.
9. Bailey, Hamilton, The Clinical Aspects of Branchial Cysts. *Brit. J. Surg.* 10:565 (April) 1923.

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cyst. The fistula may drain continuously or may close up and recur spontaneously. Drainage is usually external, but some patients have noticed internal drainage. Pain is generally absent or of mild character. However, if the mass becomes large it may cause pressure, huskiness of the voice, or even a spasmodic cough. Sometimes the cyst or fistula becomes acutely infected, causing fever.

The occurrence in men and women is about equal. The age varies from that of the infant to the aged. Some think that there may be a familial tendency in some cases. The lateral cervical cysts occur about equally on either side and occasionally are bilateral. The lateral cervical cysts are in the anterior triangle of the neck, usually just anterior to the sternomastoid muscle. The fistulas, also, are almost always in the anterior triangle, usually anterior to or along the anterior border of the sternomastoid muscle. Their position varies in level from the hyoid bone to the suprasternal notch. Often the fistulas can be felt as an identifiable cord leading upward. The cysts feel fluctuant but in some cases they may feel like a solid tumor, owing to thick walls, deep-seated location, or thick cheesy contents. Usually the skin over the cyst is smooth.

Cysts and fistulas of the thyroglossal duct are almost always in the midline and may move upward when the patient swallows. They generally are above the thyroid cartilage but may extend below. They are rarely found above the hyoid bone.

Differential Diagnosis

The diagnosis of an uncomplicated cyst or fistula can be determined accurately in a majority of cases by a carefully taken history and examination. Among the various lesions that must be thought of and differentiated are (1) cystic hygroma; (2) suppurative lymphadenitis; (3) dermoid cysts; (4) lipoma; (5) neurofibroma; (6) hemangioma and lymphangioma; (7) chronic retropharyngeal abscess; (8) tuberculous adenitis; (9) Hodgkin's disease, and (10) tumor of the carotid body.

Some of the differentiating points follow.

Cystic hygroma usually occurs or is first noticed in infancy and is usually in the lower half of the neck. The lesion is thin, diffuse and often translucent and frequently grows to great proportions, involving one entire side of the neck, one side of the face and even the arm.

Suppurative lymphadenitis may cause confusion and be difficult or impossible to distinguish from an acutely inflamed branchial cyst. Here one searches for a cause of the adenitis, such as diseased tonsils or teeth. If there is a history of intermittent drainage from a sinus, a proper diagnosis may be made by careful questioning.

Dermoid cysts are rare. They are not generally along the anterior border of the sternomastoid muscle. Often they are in the floor of the mouth under the tip of the tongue or in the area of the angle of the jaw.

Lipoma is a firm, often lobulated tumor and cannot be aspirated.

Neurofibroma masses are generally firm and solid with limited mobility, and on aspiration no fluid can be found.

Hemangioma and lymphangioma can sometimes be compressed, resulting in temporary disappearance or decrease in size of the contents. Aspiration yields blood from the hemangioma.

Chronic retropharyngeal abscess is rare but should be borne in mind. The patient's history is of great importance as a means to discovering a possible cause of the abscess.

Tuberculous adenitis causes the most confusion as the swelling may closely resemble that of a branchial cyst. Usually the mass formed by the tuberculous glands is more irregular and more adherent to the skin. In children, a careful history should

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be taken, and a tuberculin test and bacteriologic tests of the cystic contents should be made. Injection of Lipiodol (Fougera) into the swelling, in the case of the tuberculous abscess, may show an irregular outline as compared to a generally smooth outline in the branchial cyst. A roentgenogram of the chest always should be taken as an aid in the diagnosis.

Hodgkin's disease is a condition in which the mass is generally firm and lobulated. One or more biopsies, if necessary, can be performed to determine the diagnosis, together with a roentgenogram of the chest for study of glands in the chest cavity.

Tumor of the carotid body is a rare condition, and in a typical case pulsation may be noted. In one successful case, we operated on the patient, there was no pulsation and the diagnosis was determined chiefly by the location, slow growth, and resistance of the lesion to roentgenotherapy. The diagnosis was confirmed by the pathologic examination.

Laboratory Aids

Roentgenographic examination can be and is performed in cases of either cysts or fistulas after the injection of the swelling with Lipiodol (Fougera) or another radiopaque medium. However, this injection is not usually easy to make nor always reliable because of thinness of the walls and variations in the size or length of the fistula. Several workers have demonstrated the presence of cholesterol crystals in the aspirated contents of the branchial cysts and they consider that this is positive evidence of branchial cyst.

Treatment

There is almost universal agreement that operation is the best mode of treatment in lateral cervical cysts of fistulas (cysts and fistulas of the thyroglossal duct and cervical cartilaginous tabs). Fistulas of the auricular and preauricular sinuses, which are generally short, sometimes can be treated by the use of the electric coagulating needle or by sclerosing solutions. However, in these latter cases, operation usually is performed to correct the appearance as well as to cure the diseased sinus.

Cutler and Zollinger[10] advocated the use of sclerosing solutions for these conditions. They used a modification of Carnoy's fluid. This method of treatment has not been generally accepted as it is difficult to inject a fistula completely and because of the inherent harmfulness of the solution if it perforates a thin cyst or fistula.

An uncomplicated external cyst is removed by enucleation, which generally is not too difficult. This is also true of a short fistula. If the fistula is long and extends to the supratonsillar fossa, the operation becomes difficult and hazardous. The incisions advocated have been either an incision parallel to the anterior border of the sternomastoid muscle of one or more horizontal incisions in the upward course of the fistula. These incisions have been called the "stair-step" incisions. Dissection of the fistula is difficult as it is in close proximity to the great vessels and major nerves. Evert and Black[6] described the upward course of the average fistula.

> From the origin near the anterior border of the sternomastoid in its lower third, the fistula passes upward next to the muscle, passing cephalad to the hypoglossal and glossopharyngeal nerves and passing between the carotids usually anterior to the internal carotid to enter the pharynx in the tonsillar fossa which is thought to mark the remnant of the second pharyngeal pouch.

After the tract has been traced upward, management of the pharyngeal end be-

10. Cutler, E. C. and Zollinger, R., Sclerosing Solutions in the Treatment of Cysts and Fistulas. *Am. J. Surg.* 19:411 (March) 1933.

comes a problem. This problem has been handled by either cutting off the tract close to the pharyngeal mucosa, carbolizing it and tying the stump, or by inverting the small remaining stump into the pharynx or oral cavity. The technic of this procedure has been worked out by Von Hacker[11] and is shown by drawings in Christopher's[12] article. The skin wounds are closed and usually there is drainage for twenty-four to forty-eight hours.

Several aids in the removal of the tract have been used. A small probe or urethal catheter may be inserted if possible and used as a guide. Molten paraffin has been injected, which, when hardened, facilitates removal of the tract. Baumgartner[13] advocated injecting methylthionine chloride solution into the sinus tract and then washing it out with warm saline solution to remove the excess stain.

Cysts and fistulas of the thyroglossal duct are best removed by surgical excision. The fistula may pass over, under, or through the midportion of the hyoid bone. To insure complete removal of the fistula, it is considered best to incise or excise the midportion of the hyoid bone and later, when the tract has been removed, to suture together the cut halves of the bone. The fistula is tied and resected at the foramen caecum, the method of Sistrunk[14] being probably the best for this part of the operation.

Complications

Complications usually are referrable to injuries to the great vessels and to the spinal accessory and glossopharyngeal nerves. Occasionally Horner's syndrome may develop. Operation on large internal cysts is sometimes very difficult, and it may be necessary to divide the sternomastoid muscle and the internal jugular vein. Recurrence occurs in a small percentage of cases in which the lining has not been completely removed.

Summary

All swellings or lumps in the mouth and submandibular regions must be considered by the oral surgeon as possible branchial cysts and/or fistulas; and if the swelling occurs in the midline the possibility of cysts and fistulas of the thyroglossal duct must be considered. As the oral surgeon may be the first to see these lesions, he should be familiar with the differential diagnosis and treatment so that the best treatment may be given the patient.—*1136 West Sixth Street.*

11. Von Hacker, . . ., Extirpation der Kompleten Seitlichen Halsfistel Mittels Extraktion des Oberen Strangendes von der Mundhihle Aus. *Zentralbl. f. Chir.* 24:1073 (October) 1897.

12. Christopher, Frederick, The Surgical Treatment of Lateral Cervical Fistulae. *Surg. Gynec. & Obst.* 38:329 (March) 1924.

13. Baumgartner, Conrad J., Branchial and Thyro-Glossal Duct Cysts in Children. *Surg. Gynec. & Obst.* 56:948 (May) 1933.

14. Sistrunk, W. E., Thyro-glossal Duct. *Ann. Surg.* 71:121 (February) 1920.

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EDITORIAL

GENERAL ANESTHESIA IN ORAL SURGERY AND THE NURSE ANESTHETIST

NITROUS oxide and oxygen as a general anesthetic agent in the office practice of oral surgeon has been accepted for many years, and its overall record of safety is outstanding.[1] During the past decade more attention has been directed to the problem and prevention of anoxemia and anoxia which may result in cortical damage.[2]

The use of combinations of general anesthetic agents has been highly recommended by teachers of anesthesiology and has become a routine in the practice of many oral surgeons in order to permit a higher oxygen intake to assure safety without failure of adequate anesthesia for the surgery to be performed.

Thiopental sodium (Pentothal sodium) has become a popular anesthetic agent for office use by oral surgeons in spite of considerable opposition and warnings on the part of anesthetists of national prominence that it was not suitable nor indicated for oral or maxillofacial surgery. Such warnings were the result of the early tragic experiences with this anesthetic agent in overseas war installations which after thorough investigation were attributed to inexperienced administrations in bad risk cases. During the past few years, national experience has thoroughly established the fact that Pentothal sodium in combination with other anesthetic agents is not only suitable but advantageous in maxillofacial surgery, particularly where curare or curare extract (Intocostrin) is added to facilitate intubation. Curare, Pentothal sodium and nitrous-oxygen provide an anesthesia with oxygen concentration well above metabolic requirements and adequate relaxation on a high plane. Oral surgeons reporting extensive series of office administrations of Pentothal sodium alone or in combination have stressed quite properly the necessity of having all facilities at hand for the treatment of emergencies that may arise. Modern anesthesia apparatus —rescuscitators, emergency drugs, and the ability to intubate the patient should such become necessary—is essential.

Recovery rooms, well equipped and adequate in number, are necessary. The provision of such facilities too often has been neglected by dentists and oral surgeons using nitrous oxide anesthesia in office surgery, and every effort should be made to correct this situation.

Oral surgeons writing authoritatively on the subject of general anesthesia have emphasized that only trained anesthetists should administer any general anesthetics, particularly Pentothal sodium. What constitutes an adequate training? Where may it be obtained, and by whom? The national situation is indeed complex and subject to considerable controversy and discussion. A lengthy editorial in the January 1948 issue of *Surgery, Gynecology and Obstetrics*[3] calls attention to the fact. "The controversy has been pointed up by the recent action by the American Society of Anesthesiologists, Inc. This organization has circularized hospitals with a copy of a

1. Seldin, H. M., Nitrous Oxide and Potent Synergists in Oral Surgery. *J. Oral Surg.* 5:131 (April) 1947.
2. Courville, C. B., Asphyxia as a Consequence of Nitrous Oxide Anesthesia. *Medicine* 15:199 (May) 1936.
3. Beecher, Henry K., The Nurse Anesthetist. *Surg., Gynec. & Obst.* 86:115 (January) 1948.

resolution adopted by its Board of Directors, June 11, 1947. As far as the present discussion goes, the most important part of this resolution is the disapproval expressed 'Of the training of persons other than doctors of medicine in the science and art of anesthesia . . .,' in short, nurses."

It is obvious that dentists are not included in this program of the Anesthesia Societies and the American Board of Anesthesiology which requires the M.D. degree (Class A school), one year of approved internship, two years of residency in hospital anesthesia to be followed by three years of full time practice in anesthesiology. The situation is indeed complex from the standpoint of the oral surgeon. In general surgery and the specialties of surgery it is well established that the surgeon is not expected to be trained in general anesthesia and should concentrate on the surgical procedure at hand. His anesthesia responsibility is thus restricted to local and regional anesthesia.

The only situation comparable with oral surgery in a surgical specialty is that of otolaryngology. Specialists in this field have had a year or more of internship which may include some training in anesthesia and an additional two or more years of specialized training during which they are in close contact with the anesthesiology of their field. They do not, however, accept the responsibility of general anesthesia for their patients.

While the objectives of the anesthesia societies and the Board of Anesthesiology are for the ultimate improvement and safety of general anesthesia for the patient, their efforts to make a change in the desirable direction are too premature under existing conditions. It would appear that the great numbers of physicians discharged from military services and now training in anesthesia will by no means fill the vacancies in the large number of hospitals seeking trained physician heads for their anesthesia departments.

"At the same time the expansion of government facilities, as well as the civilian demand over the country is increasing. For these and other reasons it seems probable that the shortage of good men for training in anesthesia will be increasingly acute for at least several years.

"Any unnecessary pressure that adds to the critical nature of this situation will win the ill will of many physicians, especially surgeons who ought to be solidly behind the anesthetist. The resolution referred to can work to the harm of the specialty, and in addition by giving rise to strong opposition defeat its own ends.

"Dr. Evarts Graham said: 'There are some prominent anesthesiologists who would eliminate completely the nurse anesthetist. They have even supported legislation in some states which would make it illegal for a surgeon to engage the services of a nurse anesthetist. . . . The best solution to the problem then is to encourage the training of the nurse anesthetist until there are enough physician anesthesiologists to fill the demand.' We may take it that there has been widespread criticism of the policy advocated by the resolution. The policy is under discussion." Many other professors of surgery are also in sharp disagreement with this policy.[3]

At the recent meeting of the Southern Surgical Association, which was held in Hollywood, Fla., December 9, 10 and 11, 1947, the following resolution was passed unanimously by the Association:

"Although the Southern Surgical Association has been and always will be extremely interested in the advancement of all medical sciences, and particularly in anesthesia because of complete dependence on safe anesthesia for the safe performance of a surgical procedure, it, the Southern Surgical Association, heartily disapproves of the publicity given by certain newspapers and popular lay magazines

to the statements sponsored by a group of anesthesiologists who are seeking to discredit the well-trained nurse anesthetist and to compel surgeons to operate only if anesthetics are administered by physician-anesthetists.

"This attempt to persuade the public that there is grave danger in a surgical operation if the anesthetist is not a certified medical specialist is already decreasing the number of efficient well-trained nurse anesthetists and forcing surgeons to perform recently developed complicated operations with anesthetics administered by young hospital interns or general practitioners, neither of whom have special training or experience in the administration of an anesthetic."[4]

It seems obvious that in the interest of the patient's welfare, efforts must be made to counteract the immediate dire effects of the present objectives of the anesthesiologists. The training of nurse anesthetists should be resumed and new centers of training should be set up. Nurses should be assured that demands for their services will continue for a considerable number of years, perhaps on a permanent basis when many large hospitals with active surgical services will undoubtedly require several M.D. anesthetists and a number of nurse anesthetists to maintain satisfactory service.

It would seem logical that an extensive survey be made of the anesthetic requirements of America's hospitals and the means of supplying such requirements by M.D. trained anesthetists before further efforts are made to eliminate the training of the nurse anesthetists. Some definite information should be available as to the number of present medical students who are willing to embark upon the training required for the Board of Anesthesiology and whether this number would come within any measure of meeting the requirements without the additional help of nurse anesthetists.

Beecher comments further: "With the costs of all things rising to critical levels and medical care not the least of these, it seems surprising that the resolution referred to should be pressed at this time.

"If the resolution is offered with the mental reservation that it will not be emphasized until some time in the future, it still works a present effect in deterring nurses, already critically few, from going into anesthesia.

"Dangerous principles. The censorship of medical practices by society action (in so far as they lend to inflexible regimentation) may have a bad long range effect upon the society when applied to widespread general practices in the care of the patient.

"The use of a certifying board for coercive action, by threats to remove certification in order to alter widely accepted general practice may be questioned.

"There is much talk of legalistic means to force and inevitably freeze the shape of medical practice. The hazards of this have been demonstrated. Recourse to law by a medical society in order to correct what it believes to be unsound professional practices will freeze the undesirable along with the desirable. In case the law freezes inadequately tested procedures, it will be difficult to make later needed adjustments. Surely every thoughtful physician must look with deepest reluctance on moves by the medical profession to take to the law to shape its practice. Physicians need to guide their own affairs.

"The future. The nurse anesthetist is needed now; what her future position will be, the writer does not know.

"Let us not try the impossible. We cannot at present fill the available positions for physician anesthetists; therefore, of what use are impatient attempts to hasten an evolutionary process that is already proceeding faster than we can take advantage of it?

4. Blalock, Alfred, The Nurse Anesthetist. *J.A.M.A.* 136:279 (January 24) 1948.

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"Unquestionably, a well trained physician anesthetist should head the department of anesthesia, with as many physician associates as the needs of his institution require. It seems inescapable that with current shortages in this field, continued training of the nurse anesthetist is at present indicated."

A consideration of the complexity of the anesthesia situation and the controversy which has resulted in many hospitals becoming so short handed in anesthetists that operations except emergencies must often be postponed brings us face to face with the problem of general anesthesia in the office practice of oral surgery.

It must be conceded that general anesthesia in oral surgery has grown up like Topsy and the training and experience of oral surgeons and that of their nurse anesthetists is frequently below an acceptable minimum standard based on the modern concept of anesthesiology. The situation has been vastly improved by oral surgeons securing trained nurse anesthetists, but as a group they are faced with the problem of future replacements of nurse anesthetists and the question of responsibility in highly specialized field of endeavor. The answer to this problem is not immediately forthcoming and has been made much more difficult by the premature and apparently ill conceived activities of the anesthesiologists in a period of critical scarcity of nurse anesthetists.

The situation warrants immediate study and discussion on the part of organized oral surgery in order that effective arrangements may be made for the adequate training of nurse anesthetists for the specific needs of oral surgery. Such training should be at least as thorough and effective as the best training of the nurse anesthetists who have proved their worth in hospital practice.—*Carl W. Waldron.*

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The following information is needed for the National Hospital Dental Staff Roster.

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Please mail this information to Dr. Harry Archer, Chairman, Hospital Dental Service Committee, 3811 O'Hara Street, Pittsburgh 13.

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BILATERAL RESECTION OF THE MANDIBLE TO CORRECT PROGNATHISM

James R. Cameron, D.D.S.,
and J. J. Stetzer, Jr., D.D.S.,
Philadelphia

A WHITE man, aged 29, desired surgical correction of a marked prognathism (Fig. 1).

Examination.—The patient was a healthy, well-nourished young man presenting no significant medical findings. The lower jaw was edentulous, and seven carious upper anterior teeth remained. Roentgenographic examination revealed a marked elongation of the mandible. The bone was normal in appearance.

Operation.—On May 22, 1946, with the patient under anesthesia of a 5 per cent solution of thiopental sodium (Pentothal sodium, Abbott), the mucoperiosteum was reflected in the lower right and left bicuspid and molar areas. By means of an electrically operated disc saw, two vertical cuts were made in the alveoli to a depth just above the mandibular canal. The distance between each cut was 2.3 cm., which was the extent of elongation of the mandible beyond the maxillary ridge. The flaps were held with sutures for four days. Healing was uneventful.

Second Operation.—On June 3, 1946, with the patient under anesthesia of ether and tribromoethanol (Avertin, Winthrop) administered endotracheally, the musculature was reflected, through an incision below the lower border of the right side of the mandible, exposing the mandible in the molar-bicuspid area. With an electric disc saw and mallet and chisel, the predetermined block of bone was removed without disturbing the contents of the mandibular sheath. The bone was extremely hard to cut, and much difficulty was encountered in removing

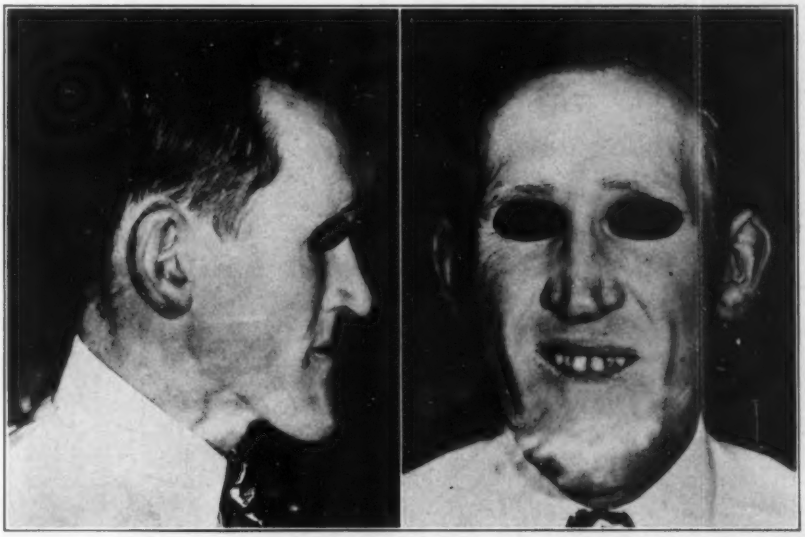

Fig. 1.—Preoperative appearance of the patient

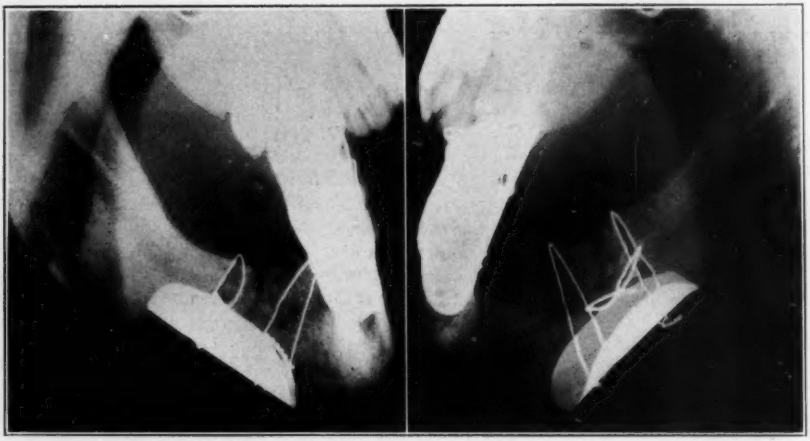

Fig. 2.—Postoperative roentgenograms, revealing interosseous wiring and tantalum cradles held by circumferential wiring

this section of bone. A Kirschner pin was placed between the fragments for stability until the left side was operated on later. Recovery was rapid and uneventful.

Third Operation.—Three days later, the patient was anesthetized with tribromoethanol and ether (endotracheally), and the left side of the mandible was exposed. A similar segment of the body of the mandible (2.3 cm.) was resected with a Gigli saw. The mandibular vessels and nerve were cut through with the bone. The Kirschner pin on the right side was removed. The loop of

Fig. 3.—Postoperative appearance of the patient wearing dentures

the mandibular vessels and nerve were countersunk in a cupped-out process about each fragment's canal. The mandible was repositioned and held with interosseous wiring on each side, plus a tantalum plate saddle which, in turn, was fixed by circumferential wiring. Recovery was uneventful, and the patient was allowed to return to his home in two weeks.

Roentgenographic Examination.—The postoperative examination of the lateral jaw showed a marked improvement in the deformity (Fig. 2). The distal fragments were held in excellent positions by the wiring and metallic saddles.

Course.—The patient informed us by mail that his condition was quite satisfactory. When he was examined six months later, however, it was evident that the tantalum saddle on the right side had broken loose and was working out through the skin.

Fourth Operation.—On December 16, 1946, with the patient under thiopental sodium (2.5 per cent) anesthesia, the tantalum plates and circumferential wires were removed, and the remaining upper teeth were extracted.

Summary.—Dentures were worn three days after the extractions (Fig. 3). The patient's appearance, masticatory function and mental outlook were extremely gratifying.

By removing the tantalum plates, we had opportunity to see the perfect tissue tolerance to the metal and also the solid bony union.

This case proved to us that it is not necessary to attempt this procedure in two or three operations, and the block resection around the nerve is of no particular advantage. Regeneration of the nerve usually returns within three months after it is severed.—*269 South Nineteenth Street.*

High Protein Therapy; Clinical Effectiveness of Oral Administration of a New Protein Preparation as Determined by Nitrogen Balance Studies. D. D. Kozoll, W. S. Hoffman, K. A. Meyer and T. Garvin, in *Arch. Surg.* 53:683, 1946.

Maintenance of the nitrogen balance by the oral intake of various protein digests has been disappointing to date, presumably because the amount of protein digests required and their bad taste eventually proved nauseating.

This article deals with the results of maintaining a positive nitrogen balance in 14 surgical patients with a new processed protein, Essenamine (Stearns), which has no odor and no pronounced taste. It can be incorporated in palatable food in large quantities without disturbance of the patient's digestive system. Essenamine is a yellow-white nonhygroscopic powder obtained by the partial alkaline reduction of lactalbumin. It contains 12.5 per cent nitrogen and is high in essential amino acid content.

The minimum requirements for nitrogen balance were determined by placing 11 of the 14 patients on a set diet, after which all were put on the high protein intake.

In 12 experiments in which Essenamine was used as the main ingredient of a high protein diet for periods ranging from seven to twenty-six days, 0.52 gm. of nitrogen per kilogram per day was given orally. This diet produced positive nitrogen balances ranging from 6 to 20 gm. of nitrogen per day, with an average of 12 gm. With the high Essenamine intake, 52.2 per cent of the ingested nitrogen was excreted in the urine, 5 per cent was excreted in the feces and 42.8 per cent was retained; this indicated the high digestibility and the high biologic value of the proteins ingested.

Both the maintenance and the high protein diet produced increases in the body weight plasma volume, the serum protein and serum albumin concentrations, and in the total circulating albumin. The diets for the minimum and high Essenamine intake are appended in the original article.—Stephen A. Zieman, in International Abstracts of Surgery, *Surg., Gynec. & Obst.* 85:205 (August) 1947.

CHOREA WITH ASSOCIATED DENTAL INFECTION

Stephen P. Mallett, D.M.D.,
Boston

A GIRL, aged 18, was transferred from Medical Service to Neurological Service at the Boston City Hospital on November 11, 1940, due to persistent involuntary jerking motions of the right side of the face and of extremities for over two weeks. The case history is given completely with consultation and remarks, in order that the neurologic and social backgrounds will be understood before the dental phase is recorded.

History.—Two years previously, the patient began to notice trembling of her fingers and had difficulty in writing during her menstrual periods. She suffered from dull generalized and frontal headaches lasting all day and occurring five to six times a week, with fleeting joint pains in her fingers and large joints. Six months previously, her mother noticed that the patient became cranky and irritable; menstrual periods became irregular and profuse with much pain and headaches; and there was a continual yellow vaginal discharge, some frequency and dysuria. The patient denied infection. She had occasional dizzy spells with some nausea (the last attack occurring two weeks before admission, while in church, and accompanied by some palpitation). Four months previously, she had had a slight cold. She had been examined five weeks previous to admission in the Gynecology Clinic for dysmenorrhea. This procedure upset the patient emotionally. No discharge was seen.

The patient had recurrent dreams about her mother being killed, and so forth, from which she awoke frightened. Two weeks before, at the onset of a menstrual period, the patient complained of a toothache on the right side and soreness of the right eye. The mother noticed twitching movements of the right eye and right side of face. The patient remained in bed because of dysmenorrhea and the involuntary facial movements cleared up partially although slight jerking of extremities was noted. On return to the Gynecology Clinic for follow-up examination, the patient suddenly developed marked jerking movements of face and extremities when the physician called her into the examining room. She was admitted to the hospital with the diagnosis of chorea. The involuntary movements continued, but without joint involvement. The heart was not enlarged. The pulse rate was 80; there were no murmurs; roentgenographic examination was normal; the electrocardiographic examination was normal with a P-R interval of 1.14 second, and the sedimentation rate was normal.

Family History.—There was no record of scarlet fever or sore throats. The patient recalled pains in the right knee and the abdomen eight years previously. Examination in the outpatient department proved negative. Four years previously mild "shingles" had been experienced and she had been threatened with "St. Vitus' dance."

Social Background.—The patient had attended parochial school under strict supervision until two years previously, when she was told she would have to repeat a year because of time missed caring for her mother who was sick. She had entered public school and passed the year before. She did not like school until the fourth year. She was told that she could not pass due to too frequent absences (during menstrual periods). Sex instruction had been given by her sister and girl friends. Recreation had been with girl friends and with boys only in groups. The family was congenial, but the girl was annoyed at times by actions of her brothers. She helped her mother and was conscientious.

Physical Examination.—The girl was well developed and fairly well nourished with a demeanor of naivety not expected at her age. Gross involuntary choreo-athetoid movements of face and extremities were displayed. The head and neck were otherwise normal. The throat membrane was slightly infected. The teeth were carious. The lungs had normal resonance, clear without râles. The heart was not enlarged; sounds were clear without murmurs. There was poor relaxation in the abdomen but no definite tenderness and no masses were palpable.

There were involuntary movements of all, and particularly the upper, extremities. The girl exhibited an overactive mental status, with some embarrassment and agitation about her condition, covered by naive threats of leaving the hospital.

Neurologic Examination.—Cranial nerves 1, 2, 3, 4, and 6 showed no abnormality except for some slight involuntary jerking movements and inability to move the jaw adequately from side to side. There were grimaces of the right side of the face, the right eye blinked often, and the right corner of the mouth jerked irregularly and laterally. Her voluntary and emotional movements were normal. A slight right air conduction impairment was revealed by the Weber test not evident by the Rinne test. The taste was normal. The vagus functioned normally. Some involuntary movements of head to right occurred without pain. Apparent weakness of both sternomastoids was evident. The tongue could not be protruded nor moved from side to side completely. There were some involuntary jerking movements but no atrophy nor fibrillation.

Coarse jerks of wide range and milder athetoid movements of extremities, mainly the upper parts and more on the right side, made all voluntary movements seem asynergic and dysmetric. The degree of movement and intensity was variable, completely ceasing during sleep. There was an impression of weakness of muscles of extremities although the tone was good.

The sensory system was normal. The left knee jerk was greater than the right, but both were exaggerated. No clonus nor Babinski's reflex was evident.

The pupils were dilated bilaterally but reacted normally. No other abnormalities were present.

Laboratory Examination.—The blood count showed: hemoglobin 88 per cent; erythrocytes 4,250,000 per cubic millimeter; leukocytes 9,200 per cubic millimeter; and the sedimentation rate 0.2. Response to the Hinton test was negative. The urine was essentially negative.

In the lumbar puncture the initial pressure was 85, final pressure 25; the fluid was clear and colorless; there were 162 erythrocytes. The reaction to the Pandy test was positive, with protein 27 mg. per 100 cc. Reaction to the gold sol test was 0122110000. The reaction was negative to the Wassermann test.

Roentgenographic examination of the skull was essentially negative. The electrocardiogram showed a normal sinus rhythm, and results of the electroencephalogram were within normal limits.

Course.—On transfer to neurologic service, the patient showed twitching of the right side of her face and violent jerking and twisting movements of all her extremities. The question of diagnosis between true Sydenham's chorea and hysteria was raised. The latter diagnosis was not stressed due to possibility of psychogenic factors in the patient's background.

Treatment.—The patient was secluded in a dark room with phenobarbital administered. No visitors were allowed. She showed only slight improvement. On December 4, 1940, she was hypnotized rather easily and suggestions were given at that time that all the involuntary movements be stopped. When the patient was awakened all the twitching, jerking movements were gone and she appeared to be asymptomatic. She remained this way for one day, but on December 6 twitching again began to appear in the right side of her face and the jerking movement in her arm recurred. However, on the next day they were gone again, and she seemed to be free of symptoms except for twitching movements of the right side of her face. She remained the same until December 9 when she was hypnotized again, this time under rather deep hypnosis. She felt that her twitching movements were due to the fact that she was afraid to go to the Gynecology Clinic. During hypnosis she was given reassurance and told that her involuntary movements were to stop. As suggested to her, all movements did stop and from that time until her discharge she remained relatively free from all of her symptoms.

Following her discharge on December 18, 1940, the patient was asymptomatic until January 8, 1941. On December 29, she had a toothache on the right side of her jaw which responded to anacin and which was unaccompanied by any involuntary movements. On the day before her admission, January 8, she was advised, following a roentgenographic examination of her teeth, to return on January 9 for extraction. On the afternoon of January 8, while chewing on some nuts, a small particle became lodged in one of her dental cavities causing sudden, severe, but transient pain. About a quarter or half an hour later, the patient's mother noted twitching

in the side of the girl's face, at first infrequent, but of increasing frequency as the evening wore on. On January 9, the facial twitchings were occurring about two to four times a minute, and there were movements (internal rotation and adduction) in the upper part of the right arm and forearm. When she was admitted, both twitching of face and movements of the arm were quite marked. At the second admission to hospital, the patient was far more cooperative and alert.

Oral Surgery Record

Dental consultation was requested on January 9, 1941.

Examination.—The patient suffered almost continuous spasms of arms and head, and lesser spasms of body and legs, more particularly noticeable on the right side, with a tendency of the head to be inclined toward the shoulder on the right side.

Roentgenographic examination presented a problem because of the constant spasms. Explosive anesthetic agents were eliminated because of their danger during examination, and either rectal or intravenous anesthetic routes were being considered. A dentist visiting the clinic showed interest in this case and suggested hypnosis, not knowing that the patient had been hypnotized previously by a physician who had since left the hospital for duty elsewhere. The visiting dentist volunteered to hypnotize the patient. Full mouth roentgenograms were taken while he did this.

Roentgenographic Diagnosis.—During study of the full mouth roentgenograms the question arose in the minds of the visiting staff as to whether one tooth or several teeth could be the possible etiologic factor. The decision was to extract one tooth at a time, selecting the maxillary right first bicuspid as the most likely involved pulp. There were many nearly exposed pulps, several impactions and several deep fillings close enough to the pulp to be causative factors.

Treatment.—On the day selected for the first extraction, the patient was in severe spasms and the anesthetic problem arose. I failed completely in an attempt at hypnosis, concluding that I had no hypnotic power. A new resident hypnotized the patient readily and, without any anesthesia, the bicuspid tooth was extracted apparently quite painlessly.

The patient was improved for four days, and then a slight recurrence of her spasms appeared. At this time it was decided to give her general anesthesia of gas-oxygen-ether and extract all possibly involved teeth, which was done on January 13.

Course.—The patient was discharged from the hospital on January 17 and was seen at the Dental Clinic several times since. She was asymptomatic. However, she was being examined by the gynecologic service regarding her menstrual difficulties and by genitourinary service for diagnosis of acute cervicitis. The opinion is that these complaints are apparently unrelated to her chorea and hysteria.

There are several facts of interest which developed between January 17 and January 23, 1941. They are:

1. The patient's domestic life was below standard.

2. She had a dietary deficiency; showed pimply, greasy, moist skin; and pallor without low hemoglobin was observed.

3. She probably had a gastrointestinal acidosis. On questioning, she acknowledged a diet consisting mostly of carbohydrates, fats, tea, and condiments.

Summary.—It is believed that dental consultation should be more frequently a routine procedure in nearly all hospital cases; that a dental pulpitis can cause various types of neurologic reactions; that care and study must be given all cases to determine a correct diagnosis; and although in this case none of the teeth extracted showed periapical involvement, there was no question of a chronic pulpitis being the etiologic factor.—*The Boston City Hospital.*

ACCIDENTS OF DENTAL ORIGIN: FOREIGN BODIES IN THE BRONCHI AND STOMACH

Ralph W. Edwards, D.D.S.,
Kansas City, Mo.

IT HAS been recognized that misfortunes occurring in the region of the oral cavity are hazardous. Prior to operation on a patient under general anesthesia, the anesthetist will require that removable prosthetic appliances be taken from the mouth in order that they will not become displaced and interfere with respiration. Yet, after anesthesia has been induced, it is not uncommon for a carious tooth to fracture when a gag is placed in the mouth. Or, during placement of mouth props or gags, a porcelain jacket crown or a porcelain facing on a bridge can be shattered, showering porcelain and cement into the pharynx and possibly the trachea. Again, teeth can be broken or avulsed in the process of endoscopy.

One must observe constant vigilance to cope with these situations. The dentist can contribute much toward the safety of his patients by greater care in the removal of teeth and by the proper retention of prosthetic appliances.

Case 1

History.—A boy, aged 10, was admitted to the University of Kansas hospital on June 24, 1944, with a chief complaint of a foreign body in the lung. On June 20, a dentist had removed the mandibular left deciduous first molar, and the tooth had slipped from the forceps and lodged in the trachea. On June 23, an attempt was made by a physician to retrieve the tooth, but without success. It was after this experience that the child was brought to the hospital.

Roentgenographic Examination.—Fluoroscopic and radiographic examinations showed an opacity in the right bronchus close to the hilus (Fig. 1, left). The history indicated this to be a tooth. There was atelectasis of the lower right lobe.

Operation.—With the patient under ether anesthesia the bronchoscopist recovered the tooth,

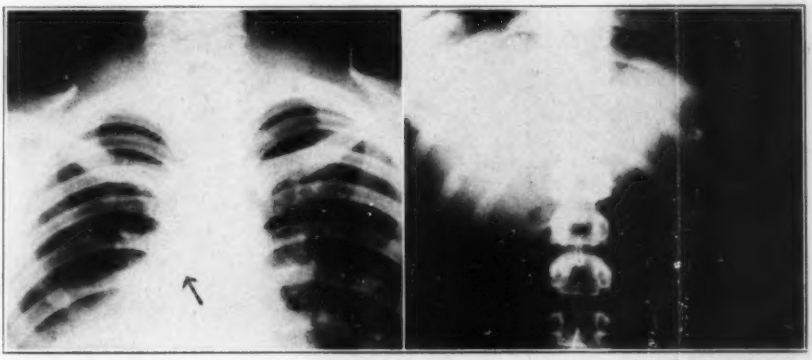

Fig. 1.—Left: Mandibular left deciduous first molar lodged in right bronchus. Right: Tooth lying in stomach

but while being brought into the mouth it was disengaged from the instrument and was lost.

Course.—A roentgenogram of the chest was negative, and re-aeration of the lower right lobe of the lung had occurred. A roentgenogram of the abdomen revealed the tooth in the stomach (Fig. 1, right). The child was dismissed from the hospital on June 25, and four days later the tooth was recovered in fecal material.

Case 2

History.—A girl, aged 6, entered the University of Kansas hospital on September 1, 1944, with a chief complaint of a foreign body in the lung. On July 15, the child's father had removed her loose mandibular incisor, but as the child was rebellious and screaming he had little control over his efforts. The tooth slipped from his grasp and with a sudden inspiration on the part of the child it disappeared into the trachea. Bronchoscopy was performed on August 14 and again on August 23, but each attempt failed to recover the tooth.

Roentgenographic Examination.—A roentgenogram of the chest showed a tooth in the right bronchus (Fig. 2, left).

Operation.—On September 1, with the patient under Vinethene (vinyl ether, Merck) and ether anesthesia, the bronchoscopist recovered the tooth from the right bronchus.

Course.—Recovery was uneventful, and the patient was dismissed from the hospital on September 3.

Case 3

History.—A woman, aged 23, entered the outpatient department of the University of Kansas hospital on March 10, 1945, with a chief complaint of having swallowed her bridge. Two days previously her dentist had placed a crown and bridge prosthesis in her mouth to restore the mandibular incisors but had not cemented the restoration to the cuspid teeth. That night the prosthesis had become dislodged and was swallowed by the patient.

Roentgenographic Examination.—Fluoroscopic and roentgenographic examinations showed a metallic foreign body overlying the third lumbar vertebra. The location suggested that it was in the colon (Fig. 2, right).

Course.—The patient was advised to inspect her evacuations daily, and on March 15, 1945, the bridge was recovered after defecation.

Comment

In reflecting on these near tragedies of dental origin, one finds apparent the fact that carelessness plays a major role in their occurrence. In the removal of deciduous

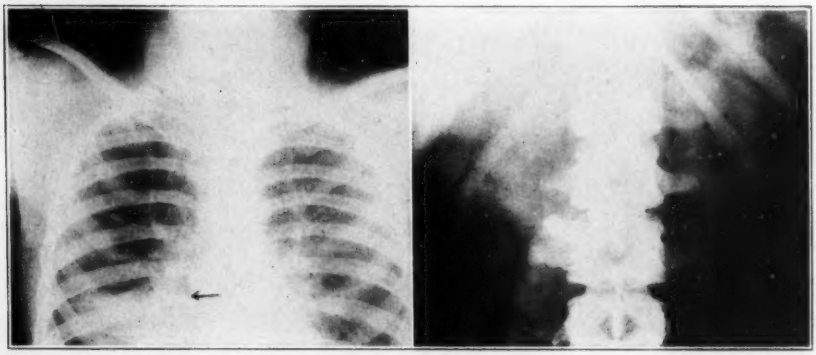

Fig. 2.—Left: Mandibular deciduous incisor lodged in right bronchus. Right: Mandibular crown and bridge prosthesis lying in colon

teeth, one must recall that the average child is more or less obstreperous and uncooperative; hence unusual caution should be observed. Particularly is this true in cases in which deciduous teeth have resorbed to the point of virtual exfoliation. Placement of forceps on these teeth or attempts at digital extirpation should not be attempted unless a gauze sponge has been placed posterior to or about the tooth to be removed.

The recovery of teeth from the bronchi, especially deciduous teeth, presents a difficult problem to the bronchoscopist. These teeth usually have most of the root resorbed, leaving only the enamel-covered crown to grasp with an instrument. The hard, dense enamel surface and the irregular contour are obstacles to the easy manipulation and recovery of the tooth.

No partial appliance should be placed in the mouth without provision being made for its retention by either clasps or a cementing substance. To avoid these cautions is to invite disaster.

Summary

Three patients with misfortunes of dental origin have been discussed. It is evident that greater care in dental extractions should be exercised with recalcitrant children, although no available means is known to control the kindly ministrations of parents who would remove the teeth of their offspring.

The retention of a partial oral prosthesis is a direct responsibility of the dentist, and means must be exercised to prevent dislodgment of such appliances.—*300 West Forty-Seventh Street.*

Deterioration of Solutions of Pentothal Sodium. M. H. Robinson, in *Anesthesiology* 8:166, 1947.

A bulk solution of 5 per cent thiopental sodium (Pentothal sodium, Abbott), prepared from commercial ampules and kept for sixty-five days at a room temperature of 18 to 22 C., was found to deteriorate steadily with time, as evidenced by the fall in melting point of extractable pentothal acid. When kept in the refrigerator at 5 to 6 C., the rate of deterioration was greatly reduced. At the lower temperature sealing the flask prevented the formation of crystals on the surface of the fluid but had no demonstrable effect on the melting point over a period of fifteen days.

Intravenous injection (at a standard rapid rate) in mice of a solution stored for thirteen days at 18 to 22 C. failed to reveal any significant change in AD50, LD50 and LD50/AD50. Statistical analysis of the bio-assay data, however, showed that although no deterioration was demonstrated, a 10 to 15 per cent loss of potency might have been obscured by the error of the method.

It is suggested that if a 5 per cent bulk solution of Pentothal sodium is to be used on successive days, it should be stored in the refrigerator and discarded according to the usual practice when turbidity appears, but until further information is available the solution should not be kept longer than three days at 18 to 22 C., or seven days at 5 to 6 C.—Mary Frances Poe, in International Abstracts of Surgery, *Surg., Gynec. & Obst.* 85:408 (October) 1947.

SQUAMOUS CELL CARCINOMA OF THE TONGUE AS A SEQUEL TO LEUKOPLAKIA

Malcolm Wallace Carr, D.D.S.,
New York

A WHITE man, aged 58, was first seen for consultation on October 29, 1932. The chief complaint was an elevated patch on the tongue about which the patient was unconcerned. He consented to be seen for consultation only at the insistence of his dentist.

History.—The family history was essentially negative; one sister had died of cancer of the breast. The medical history was negative; the patient denied both exposure to venereal disease and any history of primary or secondary lesions of syphilis. He was unmarried, traveled extensively on business and, when at home, pursued a quiet life at the home of his maiden sister. For many years he had been an immoderate pipe smoker and also smoked cigars excessively. The patient stated that he had been aware of a lesion on his tongue for nine years, during which time it had caused him no inconvenience, and that to his knowledge there had been no change in the appearance of the lesion.

Examination.—There was a broad, slightly raised, irregular, circumscribed white plaque on the dorsum of the tongue. It covered the entire central area of the anterior two-thirds of the tongue, leaving an unaffected margin to the lateral borders and the tip of the tongue of only 1 to 1.5 cm. Arising from the center of this large patch was a moderately large sessile papillary node presenting a cauliflower-like appearance. There was a smaller papillary node to the right and slightly posterior to the central node. There were a number of superficial disseminated fissures within the circumscribed patch. There was no ulceration. The tissue lateral to the central lesion and toward the tip of the tongue showed atrophic glossitis, having the appearance of bald tongue, in which condition the tongue appears entirely smooth, owing to atrophy of the filiform papillae, a condition recognized as a sequel to syphilis. Palpation elicited

Fig. 1.—Left: Leukoplakia of tongue. Dorsal surface shows large papillary node, seat of later malignant degeneration, arising from larger area of keratinized epithelium. There is also atrophic glossitis. Photograph taken in October, 1932. Right: Squamous cell carcinoma of tongue. There is extensive malignant involvement of left lateral aspect, arising from papillary node in central portion of dorsum and extending back to base of tongue. There is marked inflammatory reaction with ulceration. Photograph taken in November, 1936, of same patient as shown at left

a hard, leathery, dry, hornified lesion. There was marked induration and distinct keratinized epithelium (Fig. 1, left). There was no tenderness and no pain. Regional lymph nodes in the neck were not palpable. Reaction to the Wassermann test was 4 plus. The diagnosis was advanced leukoplakia of the verrucose or papillomatous type, and syphilis. The patient was advised to discontinue the use of tobacco, special oral hygiene was instituted and careful examination was conducted to discover any sources of local irritation. Potassium iodide was given as a preliminary to a routine course of intravenous specific treatment for syphilis, and wide surgical removal of the lesion was recommended.

Course.—The patient was seen once within the first two weeks after the examination and then failed to return until four years later. He had discontinued smoking but none of the other recommendations had been followed.

Examination.—The dorsal surface of the tongue after four years of neglect showed increase in elevation and hornification of the large white plaque that occupied the entire central portion of the tongue. The most pronounced change had occurred in the appearance of the two papillary nodes that arose above the larger area of keratinized epithelium. The papillary node in the central portion of the tongue was more than twice the size of the original lesion and measured 3 by 1.5 cm. Extension had taken place to the left and posteriorly where there was a deep linear ulcerated lesion measuring 3.5 cm. in length. In this region there was marked evidence of secondary infection with deep infiltration, the lesion appearing not unlike a carbuncle. Solid induration of the posterior third of the tongue extended well back to the base where there was little ulceration but deep infiltration. There was no evidence of infiltration into the floor of the mouth. Immediately adjacent and to the right of the central papilloma was the smaller similar lesion which also had increased in size since the initial examination but did not show cracking, ulceration or independent infiltration (Fig. 1, right). There was moderate fixation of the tongue. Pain was pronounced, eating had become difficult, and the patient had lost weight. The posterior submaxillary lymph nodes were palpable and slightly

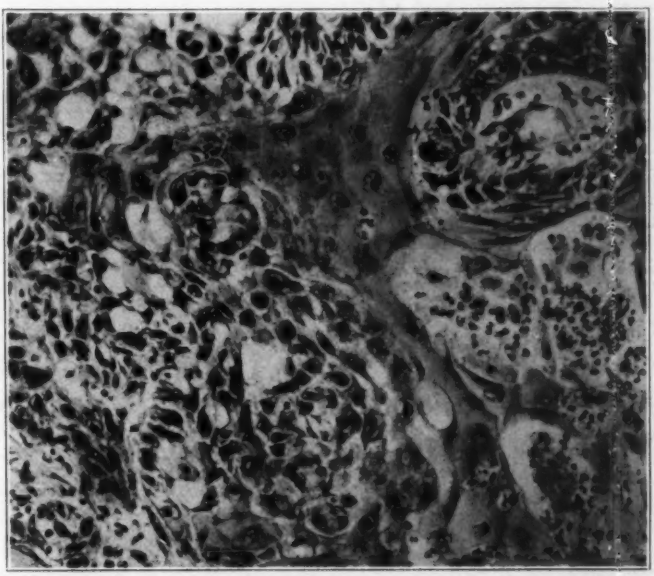

Fig. 2.—Photomicrograph of squamous cell carcinoma (grade 2) of lesion shown in Figure 1, right. Section made after complete glossectomy

enlarged, the one on the right side just below the angle of the jaw measured about 1.5 cm. and the one on the left side in the same position about 1 cm. The superior and deep cervical nodes were not palpable. There was consequently little clinical evidence of metastasis to the regional nodes. Findings in general physical examination were negative. The patient gave negative reactions to Wassermann and Kahn tests and to tests for presence of alcohol and cholesterol. Four years earlier, at the time of the initial examination, the patient's reaction to the Wassermann test had been 4 plus. The later negative reaction is unexplained, as the patient gave no history of antisyphilitic treatment, and the tests in both instances were made by equally careful workers.

Diagnosis.—Provisional clinical diagnosis of carcinoma was confirmed by biopsy, which showed squamous cell carcinoma, grade 2 (Fig. 2). Carcinoma is graded from slow growing types with a high degree of differentiation (pearl formation) and few mitotic figures (grade 1) to fast growing malignant types with many mitotic figures and many undifferentiated cells (grade 4).

Treatment.—The region of the tongue involved in the tumor was too massive for primary treatment with radium or roentgen ray radiation, as the dosage would be necessarily so large that osteomyelitis and necrosis probably would result. There was, however, little clinical evidence of metastasis to the regional nodes. It therefore was decided to administer a preliminary course of roentgen ray radiation to the neck and perform a complete glossectomy. Accordingly, the patient received, in divided doses, a total of 700 roentgens to each side of the neck, and subsequently total cautery glossectomy was performed, the dissection being carried back across the base of the tongue, resulting in removal of the entire organ.

Pathologic Report.—Examination of the gross specimen showed extensive carcinoma of the dorsum and left lateral aspect, extending back to the base of the tongue. In addition to the lesions described in the clinical examination, the specimen showed a mass of tumor tissue beneath the ulcerated lesion, measuring 3 by 2 by 2 cm., and in the left central portion of the tongue a separate and distinct tumor lying beneath the mucosa and infiltrating muscle tissue, measuring 2.5 by 1.5 by 1.5 cm.

Outcome.—This patient was seen at regular intervals for follow-up examination during the succeeding ten years. When last seen in 1942 he had had no recurrence or metastasis and was successfully engaged in business.

Conclusions

1. A case report is presented of squamous cell carcinoma of the tongue, which developed from a pre-existing lesion of papillary leukoplakia.
2. The report is presented essentially as a clinico-pathologic study and a report of a cure after a ten year period of observation rather than as a study of operative surgery or radiation in the treatment of malignant neoplasms, because of the special opportunity afforded in this case to observe, clinically and pathologically, the transformation of papillary leukoplakia to squamous cell carcinoma.
3. Leukoplakia is a precancerous lesion with an ultimate tendency toward malignancy.
4. It is probable that early treatment of the leukoplakia in this case would have prevented cancer and cured the leukoplakia.—*52 East Sixty-First Street.*

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REMOVAL OF ALL TEETH AND ALVEOLECTOMY COINCIDENTAL WITH CEREBRAL ACCIDENT

Edward C. Thompson, D.D.S.,
Urbana, Ill.

A WHITE man, aged 71, came to the Carle Hospital Clinic on March 22, 1941, complaining of severe dizziness, headaches and backache.

History.—He had always enjoyed good health and had been very athletic. Several weeks prior to this date he had noticed dizziness and backache. The patient remarked that he had "stumbled along like a drunk man." On February 11, 1941, while taking a bath, he had fallen and struck his right cheek against an iron pipe. He had not lost consciousness and had carried on his usual daily activities. On the next day he had suffered a severe backache.

Examination.—Examination showed that the patient's gait was unsteady and staggering. He fell frequently toward the left and occasionally to both sides while undressing. He was seen in consultation by an ophthalmologist, an otolaryngologist, a dentist, a neurologist, an orthopedist, a roentgenologist (Fig. 1) and an internist. Marked tonsillar and dental sepsis was found. Reports on all other studies were negative.

At that time it was felt that diagnosis of either toxic vertigo or possible cerebral injury could be made. Since the patient's backache, dizziness and staggering were becoming quite severe, it was decided that spinal puncture should be performed, and that, if the fluid were bloody, a diagnosis of cerebral injury should be made and oral surgical procedures postponed. However, the spinal fluid was normal and, although cerebral injury could not be absolutely ruled out, it was felt that diagnosis of toxic vertigo was most probably correct.

Operation and Outcome.—On this assumption the patient's remaining lower teeth were removed on April 1, 1941, under local anesthesia, and conservative alveolectomy was performed. There was no severe local postoperative reaction. Nothing of note occurred until the fourth day after the operation, at which time the patient's temperature, taken by rectum, rose to 100.2 F. On the morning of that day the patient became drowsy and stuporous but was able to talk coherently and complained of pain in the back of his neck. By noon aphasia and hemiplegia of the right side had developed, signifying cerebral accident, probably on the left side. The patient became comatose rapidly; by the morning of the fifth day after operation he became critically ill, and neurologic findings and history were compatible with subdural hemorrhage. On the afternoon of the same day exploratory craniotomy was performed. A chronic subdural hematoma was found to have resulted from hemorrhage caused by the contrecoup coincidental with the blow to the patient's right cheek.

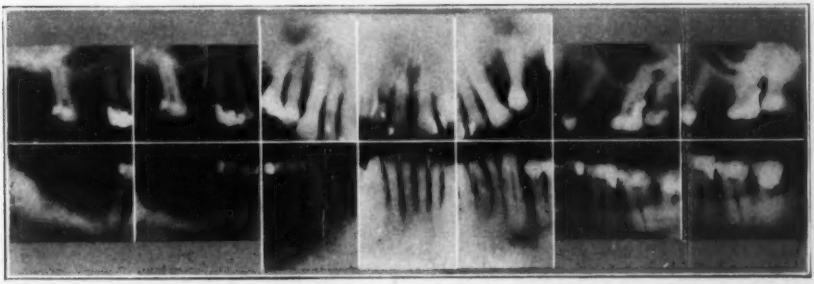


Fig. 1.—Preoperative dental roentgenograms showing extensive periodontal infection

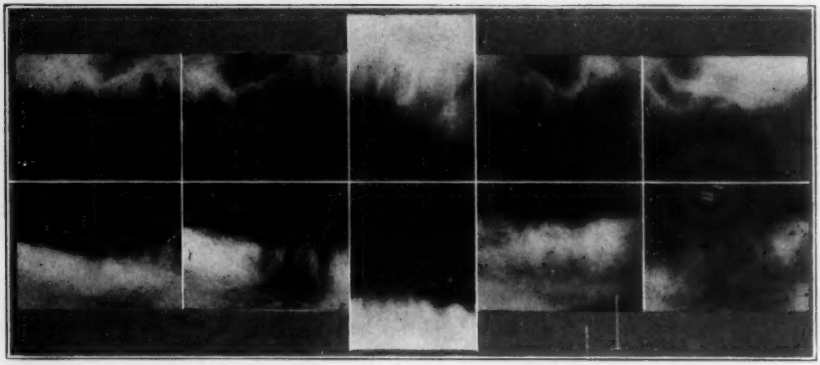


Fig. 2.—Postoperative dental roentgenograms

The patient rapidly returned to normal and was discharged from the hospital one month after craniotomy. After a month's convalescence at home the patient was again hospitalized and all upper teeth were removed and alveolectomy was performed under local anesthesia (Fig. 2). A week later full upper and lower dentures were placed by the patient's dentist.

Comment.—It is interesting to note that the change in the patient's condition was not caused by progressive or recurrent hemorrhage but by a simple physiologic change. Expansion of the clot which resulted from hemorrhage, through degeneration of the red blood cells, caused absorption of fluid by osmosis through the clot wall from surrounding spinal fluid and brain tissue, resulting in compression of the brain. This case presents an interesting diagnostic problem from a medical standpoint and illustrates one of the hazards of undertaking oral surgical procedures on patients thought to be suffering from toxic vertigo.—*602 West Washington Avenue.*

A Study of Systolic Blood Pressure and Pulse Rate in Traumatic Shock. John D. Stewart, Paul A. Kennedy and Harry W. Hale, Jr., in *Surg., Gynec. & Obst.* 85:453 (October) 1947.

1. Values for systolic blood pressure and pulse rate in 204 freshly gravely wounded soldiers have been examined.

2. In nonfatal as well as fatal cases the systolic blood pressure under restorative therapy tended to rise toward normal, whereas the pulse rate tended to rise away from normal.

3. Coefficients of correlation between systolic blood pressure and pulse rate are shown to be quite low both before and after restorative therapy and surgical operation.

4. Systolic blood pressure appeared to have more prognostic value than pulse rate, though both showed more deviation from the normal in fatal cases than in the group as a whole.

5. Systolic blood pressure and pulse rate in traumatic shock should be considered as representing the monetary effect of varied and compounded physiologic reactions. The frequency of exceptional values indicates that these two factors require caution in the evaluation of the state of traumatic shock.

OSTEOMYELITIS WITH DESTRUCTION OF THE CORONOID PROCESS AND SUBSEQUENT REGENERATION

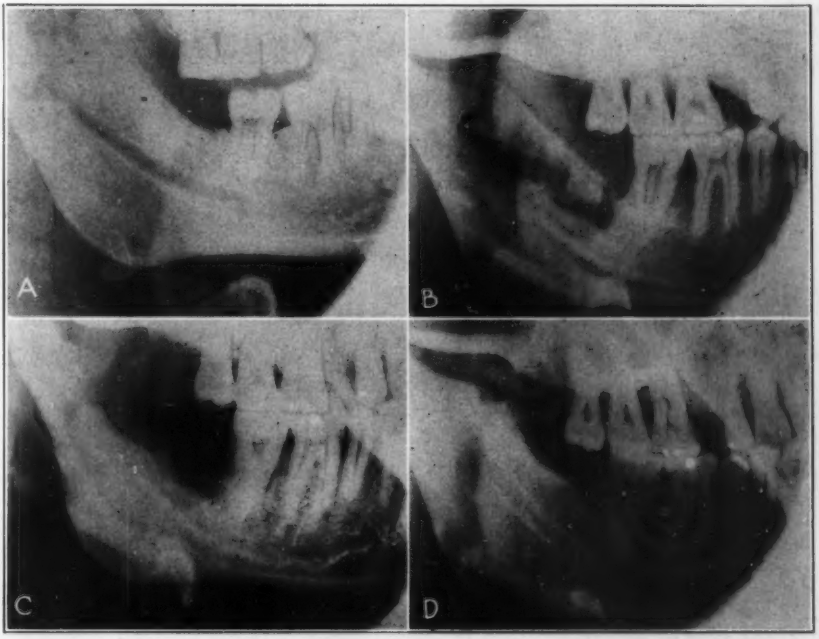
Alvin L. Armer, D.D.S.,
Hollywood, Calif.

A WHITE man, aged 39, was seen for consultation on June 2, 1938. He complained of excruciating pain in the lower left side of the face.

History.—On May 27, 1938, a mandibular third molar with an infected flap had been removed with the patient under local anesthesia. He had been in continuous pain since May 28, and the swelling was progressing.

Examination.—His face was swollen from the temporal region to the region below the angle of the jaw and anteriorly to the mental foramen region. The gingival tone and oral hygiene were within normal limits except that the lower left third molar socket was very inflamed. Roentgenograms disclosed no root fragments nor foreign bodies (see illustration, A). His temperature was 103.2 F.

The patient was a well-nourished man, 5 feet 8 inches tall, weighing 186 pounds, with no defects or complaints except his present illness.



Roentgenograms of lateral jaw. A, no evidence of osteomyelitis (June 2, 1938). B, large sequestrum (July 14, 1938). C, condition at end of active treatment (July 25, 1938). D, regeneration of coronoid process (January 12, 1939)

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Laboratory Examination.—The blood count showed: hemoglobin 13.2 gm.; erythrocytes 4,200,000 per cubic millimeter; leukocytes 8,500 per cubic millimeter; lymphocytes 56 per cent; neutrophils 42 per cent; basophils 0.2 per cent; transitionals 0.4 per cent; bleeding time four and a quarter minutes; and coagulation time four and a half minutes.

Treatment and Course.—The patient was anesthetized under nitrous oxide and oxygen, an incision was made along the mucobuccal fold from the first molar back and up the ascending ramus and a drain was inserted. The patient was placed on a sulfanilamide treatment, 60 grains a day, and the wound was irrigated daily with Dakin's solution. His temperature dropped to normal, and the pain was negligible within twenty-four hours. On June 14, he was anesthetized under nitrous oxide and oxygen, and the incision was extended up the ascending ramus approximately to the sigmoid notch to obtain more adequate drainage. Daily irrigations of saline and Dakin's solutions were used. After each irrigation, allantoin ointment was injected into the wound.

On June 29, a roentgenogram was taken which disclosed that the bone was "honey-combed" from the second molar back up the anterior half of the ascending ramus, and the coronoid process was detached from the ramus in a sequestrum. The daily routine as stated previously was continued until July 14, when sequestrum formation appeared to be complete (see illustration, B). At this time, a crepitus sensation was noted over the coronoid process when the patient opened and closed his mouth. On July 16, he was anesthetized with ether, the incision was extended up the ascending ramus and the sequestrum was exposed. The sequestrum was detached completely with the exception of a few fibers of the temporalis muscle which were attached to the tip of the coronoid process. These fibers were divided, and the coronoid process was removed. The wound was packed with iodoform gauze in order to keep the periosteum in the original form. The wound was irrigated daily and repacked with iodoform gauze soaked in 0.4 per cent allantoin solution. This procedure was continued, and the packing reduced as granulation progressed (see illustration, C). The patient was observed periodically until January 12, 1939, when healing was complete and he was dismissed (see illustration, D).

Results.—The patient recovered with no defects in esthetics or masticating ability. The temporalis muscle had not atrophied and was functioning.

It was evident that although the sequestrum formation caused the loss of the coronoid process and the anterior portion of the ascending ramus constituting the loss of the greatest portion of the insertion of the temporalis muscle, generation did take place, and there was no atrophy of the temporal muscle.—*6331 Hollywood Boulevard.*

Penicillin and Osteomyelitis. F. O. Alarcon, in *Rev. Asoc. méd. argent.* **61**:5, 1947.

The author believes that osteomyelitis and osteitis develop from inoculation by way of the blood stream, from an exogenous source, or from a small contiguous infectious focus. He believes that penicillin has definitely lowered the mortality rate and the number of complications, but reserves his opinion regarding a total cure and the possibility of sterilizing a focus.

The doses should be large parenterally and locally. If there is no tendency toward resorption of the sequestra, resort to surgery is indicated. Abscesses should be drained.

Osteomyelitis is never cured if there is an elevated blood count, and in chronic osteomyelitis, penicillin therapy should accompany the Orr treatment. Surgery should not be omitted when penicillin is used; rather the latter is an auxiliary to surgery, particularly when a compound fracture is present.—Stephen A. Zieman, in International Abstracts of Surgery, *Surg., Gynec. & Obst.* **85**:282 (September) 1947.

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CAVERNOUS HEMANGIOMA OF THE SOFT PALATE

James B. Smith, D.D.S., M.S.,
Danville, Pa.

On July 9, 1945, a white girl, aged 18, was referred to the oral surgery department of the Geisinger Memorial Hospital.

History.—She complained of a growth in her mouth which was first noticed at the age of 1 year. She had experienced no pain nor bleeding from the area, but the tumor mass did cause some interference with speech.

Examination.—Examination of the mouth revealed a smooth, deep red mass approximately 3 by 4 centimeters in size bulging into the mouth from the left side of the soft palate (Fig. 1, left). The mass was soft and compressible but immediately resumed its shape when pressure was removed. There was no pulsation in the tumor.

The patient was admitted to the hospital on July 25, 1945, where complete physical examination failed to reveal any other abnormalities. The urine analysis was normal. Reactions to the Kolmer and Kahn tests were negative. The bleeding time was three minutes and clotting time three and a half minutes. A blood count revealed the following: hemoglobin 71 per cent; erythrocytes 4,420 per cubic millimeter; leukocytes 4,900 per cubic millimeter; color index 0.8; neutrophils 53 per cent; eosinophils 2 per cent; small lymphocytes 43 per cent; and metamyelocytes 2 per cent.

Diagnosis.—The diagnosis of cavernous hemangioma of the soft palate was made.

Treatment.—On July 26, 1945, she was given 1½ grains of sodium propylmethylcarbinylallylbarbiturate (Seconal, Lilly) in preparation for injection of a sclerosing solution into the blood sinuses of the tumor in order to destroy the epithelial lining of these spaces and so cause obliteration of the space by the formation of fibrous tissue in this area. About 1 cc. of a 2 per cent solution of procaine with 1 to 50,000 parts of epinephrine was deposited at the posterior palatine foramen in order to gain anesthesia over the left side of the soft palate. Two cubic centimeters of sodium salts of psyllium seed oil (Sylnasol, Searle) was injected into one of the cavernous spaces which made up the tumor, after inserting the 22 gage needle and withdrawing the plunger to be sure that the Sylnasol would be injected into one of the sinuses. She required one dose of 10 grains of aspirin for control of pain on the same afternoon but suffered no other complications and was discharged from the hospital on the following day, July 27.

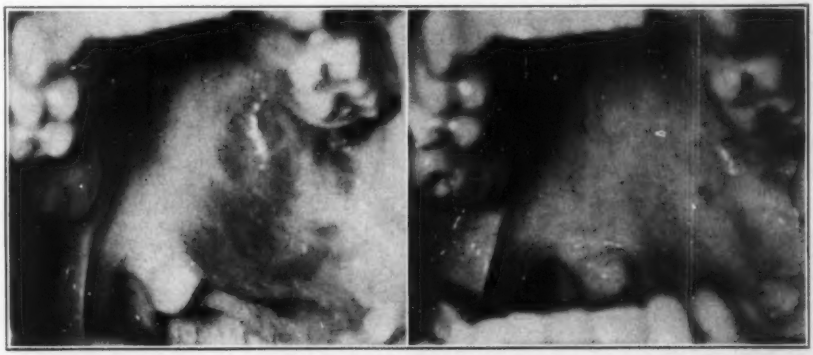

Fig. 1.—Left: Cavernous hemangioma of the soft palate. Right: Postoperative appearance, showing almost complete regression of the tumor

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Since the reaction to the first injection had been so slight, it was decided to carry out the rest of her treatment as an outpatient. She returned on August 7, 1945, at which time 1 cc. of Sylnasol was injected into one of the blood sinuses using 2 per cent procaine anesthesia as before. This procedure was repeated four more times at approximately one month intervals with the last injection on November 16, 1945.

The accompanying photograph taken April 26, 1946, shows almost complete regression of the tumor (Fig. 1, right).

Summary.—This is an example of a slow growing benign hemangioma. It had caused considerable interference with speech, and the walls of the blood sinuses were so thin that there was a definite danger of severe hemorrhage following accidental trauma to the tumor. It is important that this type of tumor be recognized without biopsy for an incision is sure to be followed by severe and prolonged bleeding. When in doubt it is, therefore, advisable to attempt to aspirate any tumor which is easily compressible. If a fine gage needle is used, aspiration of this type is not apt to be followed by severe hemorrhage.—*Department of Oral and Maxillofacial Surgery, Geisinger Memorial Hospital.*

Survival in Bone Sarcoma. H. Platt, in *J. Bone Surg.* 29:6, 1947.

Certain broad conclusions concerning the effectiveness of various methods of treatment of bone sarcoma are drawn from the Registry of the American College of Surgeons and from individual contributions by Coley, Campbell, Meyerding, Simmons, Macdonald and Budd.

Surgical eradication of accessible tumors is the treatment of choice. The value of postoperative treatment by means of irradiation on toxins seems to be still *sub judice,* but these therapeutic agents should not be withheld from a patient if circumstances permit their systemic use.

The outlook in the case of osteogenic sarcoma is not so gloomy as it appeared at one time. The spindle-cell sarcoma (fibrosarcoma) appears to be the least malignant form. The opinions regarding the degree of malignancy of chondromyxosarcoma and extraperiosteal sarcoma are conflicting. The prognosis in Ewing's tumor remains grave, despite its response to irradiation. Thirteen of the 14 patients who were recorded as having Ewing's tumors in the Registry report of 1939 survived for five years after treatment by surgical measures.

The author has submitted his collection of 161 cases of sarcoma. There were 23 cases with five year survival, of which 22 were treated by radical operation, and the survivals were fully proved. The other case, a pelvic sarcoma, was not subjected to biopsy. Of 2 patients with pelvic sarcoma treated by hindquarter amputation, 1 lived five years and the other is still alive after seven years. Eight patients in this series survived more than ten years.

An attempt has been made to compare certain factors in the long survival cases, with the same factors in a series of 49 short survival cases (under two years). No significance can be accorded to such factors as age, sex, site of tumor, and duration of symptoms before the tumor was eradicated. Of 128 patients with accessible tumors which were treated radically, 79 patients survived more than two years, and 23 of these for five years or more. The author states that irradiation is admittedly a useless form of therapy in tumors of the osteogenic sarcoma type. In Ewing's tumor, irradiation before amputation, or irradiation alone in accessible tumors, has no material influence on the ultimate fate of the victim of this most lethal type of bone tumor.—Daniel H. Levinthal, in International Abstracts of Surgery, *Surg., Gynec. & Obst.* 85:175 (August) 1947.

UMI

MULTIPLE FRACTURES OF THE MANDIBLE IN A CHILD

Edward Reiter, D.M.D., M.S.,
Cleveland

A BOY, aged 7, sustained multiple fractures of the mandible in an automobile accident.

Examination.—One fracture line was in the region of the symphysis between the left lateral incisor and the deciduous cuspid tooth. Another fracture was at the neck of the left condyle, and a third fracture site was at the neck of the right condyle (Fig. 1, left). The fractures in both condylar regions allowed the chin to fall back into a marked retrusive position. In the anterior region, one fragment of the broken mandible overlapped the other (Fig. 2).

There is nothing unusual about bicondylar fractures in adults, but they are rare or unusual in children 7 years of age. The age of this child made it necessary to improvise the treatment. Splints could not be constructed and the intermaxillary wiring could not be employed because

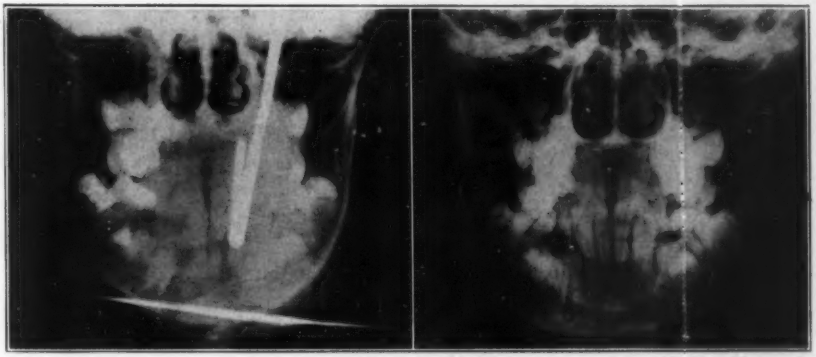

Fig. 1.—Left: Fracture sites at the neck of each condyle. The over-riding fragments in the anterior region have been reduced and immobilized by a Kirschner pin. Right: Roentgenogram showing absorption of the short fragments at the neck of each condyle and a bony union. Compare with figure at left where short fragments protrude laterally

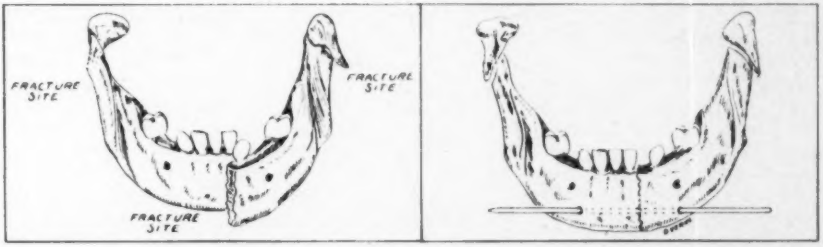

Fig. 2.—Left: Fractures at the neck of each condyle and a fracture between the lateral incisor and the left deciduous cuspid. The left permanent lateral was lost in the accident. Right: Reduction of the fracture with immobilization maintained by a Kirschner pin

Fig. 3.—Left: Kirschner pin running through the symphysis, with rubber bands for traction which are attached to a wire coat hanger incorporated in a plaster of paris head cap. Right: Postoperative appearance, showing chin in good position. The scars in the skin through which the Kirschner pin emerged can be improved by excision.

the first molars, the lateral incisors, and the central incisors were the only permanent teeth in the mouth. They could not be used because they were only partially erupted.

An open reduction was considered, but the idea was abandoned just as promptly. An open reduction would have reduced the fracture in the region of the symphysis, but it would not

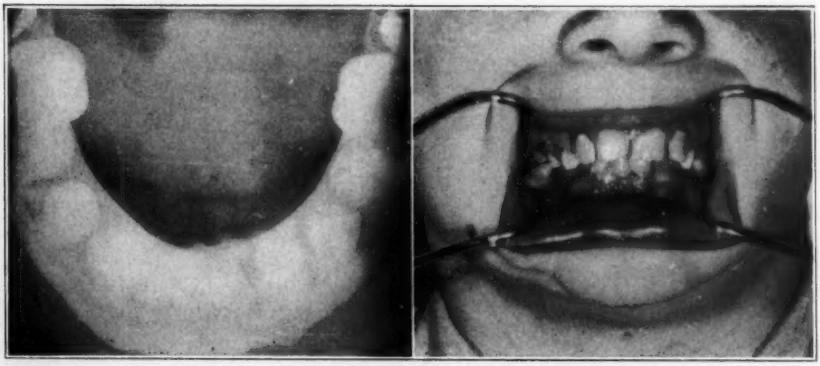

Fig. 4.—Left: Roentgenogram, showing good alinement of the anterior fragments and a bony union. Right: Postoperative appearance, showing teeth in a relatively normal articulation one year after reduction of fractures

have corrected the retrusive position of the chin. Open reduction of the neck of the condyle was too formidable an operation.

Operation.—The boy underwent surgery on September 22, 1945. He was anesthetized under nitrous oxide-ether anesthesia. When he was asleep the anterior fragments were reduced by digital manipulation and held in alinement until a heavy Kirschner pin was drilled through the symphysis (Fig. 3, left). The Kirschner pin immobilized the anterior fragments and also aided in the reduction of the fractures at the neck of each condyle.

A plaster head cap was made and a heavy wire coat hanger was incorporated into the plaster cap. The hook of the coat hanger was bent down in front of the face in such a manner that rubber traction could be utilized with it. Rubber bands were placed on the hook part of the coat hanger, and one end of each rubber band was attached to one end of the Kirschner pin. By constant traction the chin was brought forward until the lower anterior teeth were in a relatively normal position with the upper teeth. Rubber traction was maintained for a period of six weeks.

Comment.—Multiple fractures of the mandible in a 7 year old boy is reported. The case is reported because of the method used to reduce the fractures. A Kirschner pin immobilized the anterior fragments and held them in good alinement (Fig. 4, left). The pin was also used for rubber traction in a reduction of the condylar fractures. A wire coat hanger was incorporated in a plaster of paris cap. One particular advantage of this treatment was that it enabled the boy's mandible to function during the mastication of soft food through the six weeks of treatment.—*1114 Republic Building.*

The Surgical Treatment of Epitheliomas of the Face and Buccal Cavity, with Especial Reference to the Immediate Plastic Repair. M. C. Provecho, in *Rev. espan. cir.* 2:453, 1945.

Metastases in cancer of the face occur in 1 per cent of the cases. Secondary growth may be found in distant organs. The mortality rate is relatively high and should be reduced because the location of the tumor is typical, easily accessible and diagnostically simple.

Treatment, on the other hand, results in much pain and mutilation. This is brought about partly by the application of therapeutic agents which are to be condemned. The application of nitrates, various caustic pastes or carbon dioxide often results in unnecessary disfigurement and inadequate treatment. The collaboration of surgeon and radiologist is often disappointing because the treatment falls into a vicious circle. The radiologist has no opportunity to treat the surgical case when indicated and the case is submitted to radium or roentgen rays when neither is of value. The principal objection to surgery is that often a considerable amount of tissue has to be sacrificed and much plastic repair has to follow if deformity is to be avoided.

The author presents the indications and methods of treatment to be employed in the various epitheliomas of the face and mouth. This therapy is based on experiences gained in the surgical section of the National Institute for Cancer in Madrid.

The principal indications for surgery are that the tumor is of large size, near the bone or cartilage, radio resistant, recurrent or precancerous in type. When metastasis has occurred to the lymphatics, these should be removed at the time of operation.

Surgery is contraindicated when the lesion is reasonably incurable, the general condition of the patient is bad or infiltration has extended to the deeper glands.

Immediate plastic repair with various types of grafts is emphasized. Diathermy coagulation and extirpation is resorted to when indicated, particularly in the recurrent type of tumor, and extension of growth into the craniofacial bones requires special consideration according to the bones involved.—Stephan A. Zieman, in International Abstracts of Surgery, *Surg., Gynec. & Obst.* 85:127 (August) 1947.

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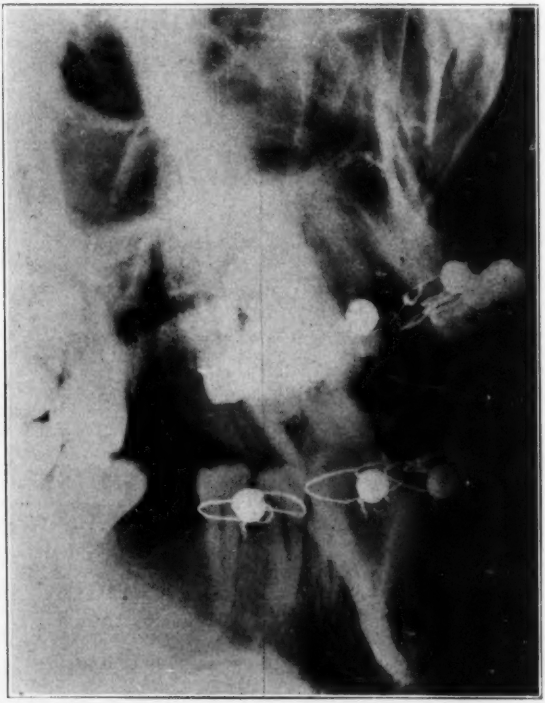
BILATERAL FRACTURE OF THE MAXILLA

Paul H. Hamilton, D.D.S.,
Los Angeles

A MAN, aged 20, was brought to the hospital on September 1, 1940, after having been involved in an automobile accident. His chief complaints were pain and swelling in the region of the maxilla and inability to bring the maxillary anterior and bicuspid teeth into occlusion.

Examination.—The patient was conscious and cooperative. There was a small laceration of the chin and swelling of the tissues over the maxilla and nose. Oral examination disclosed a break in the continuity of the maxilla between both the right and left second bicuspids and first molars. The mesial surfaces of the roots of the first molars were exposed, and there were openings in these areas into both maxillary sinuses. The anterior part of the maxilla was firmly impacted cranially to the extent that the incisor teeth were 2 cm. out of occlusion. There was much clotted blood in the mouth and nose but no active bleeding.

The roentgenogram of the maxilla revealed that the greater part of the alveolar portion of the maxilla anterior to the first molars was impacted cranially and dorsally into the antral and



Roentgenogram of fractured maxilla, showing cranial impaction and displacement

nasal regions (see illustration). Both antrums were opaque, a condition which was consistent with hemorrhage.

All general physical findings were within normal limits. Reactions to the Wassermann test and the Kahn precipitation test were negative.

Treatment.—On the second day after the accident, the upper first molars were removed, with the patient under procaine infiltration anesthesia. Interdental rubber traction bands were put in place on September 5. After a few days it became obvious that the impaction would not be relieved with this type of traction. On September 11, with the patient under ether anesthesia, the impaction was reduced by elevator pressure in the molar sockets combined with digital pressure on the labial sector of the incisive region. After the patient had recovered from the anesthesia, the teeth were brought into normal occlusion by placing interdental wires on the teeth and adjusting the wires daily for a few days. The interdental wires were left in place for three weeks and were removed on October 7.

Course.—When the patient was examined three months after the accident, on November 26, the union of the fracture was firm and the teeth were in normal occlusion. There was complete healing of the first molar sockets without evidence of openings into the maxillary sinuses. The maxillary sinuses showed no evidence of disease.—*1200 North State Street.*

Classification of Maxillofacial Injuries. D. Klein, in *Plast. & Reconstr. Surg.* 2:133, 1947.

The author reviews a series of cases of maxillofacial injuries admitted to an evacuation hospital.

A plan of care was evolved in which evaluation of the injuries and classification of the varying degrees of such injuries were made. This plan made possible more accurate diagnosis and a better approach to treatment and prognosis. The application of these findings to civilian practice has been noted by the author.

Because of the wide variation in the extent of the injuries and problems involved in caring for the patients, group classifications were made:

Group 1. Primary maxillofacial injuries.
  (a) Without hemorrhage or obstruction
  (b) With (1) hemorrhage, (2) obstruction, or (3) both
Group 2. Maxillofacial injuries with concomitant wounds.

The patients in Group 1a were usually comfortable, with little need of sedation, and they exhibited few, if any, signs of clinical shock regardless of the severity of the injuries. Extensive primary repairs were well tolerated.

The patients in Group 1b suffered, in addition, from noticeable loss of blood, respiratory obstruction or both; they were acutely ill and presented many manifestations of clinical shock.

Treatment was directed to replacement of the lost blood and the establishment of an adequate airway. When these criteria were met, primary reparative surgery of any degree was carried out as in the first group.

In Group 2, with facial injuries and concomitant cerebral, thoracic, abdominal or extremity injury, treatment of the facial injuries was carried out concurrently with that of the other injuries in the belief that recovery was not compromised, and minimal scarring and deformity were the results. The principles of immediate reparative surgery or early repair were adhered to and emphasized, and particular attention was paid to patients developing unexpected signs and symptoms. Concealed injuries were suspected in these cases.

Excellent case histories illustrate the course and treatment of the cases in each classification; the medical, surgical and mechanical data are complete.—Frederick W. Merrifield, in International Abstracts of Surgery, *Surg., Gynec. & Obst.* 85:231 (September) 1947.

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The Stability of Thrombin, Penicillin or Streptomycin, in the Presence of Gelatin Sponge, Oxidized Cellulose or Each Other. John T. Correll and E. C. Wise, in *Surg., Gynec. & Obst.* 85:211, 1947.

The enzyme, thrombin, and the antibiotic, penicillin, were both rapidly destroyed by oxidized cellulose. This is apparently due to the lowering of the pH of such solutions by the gauze, for thrombin or penicillin were also unstable in solutions buffered to a pH corresponding to that produced by pieces of oxidized cellulose.

Thrombin or penicillin showed no loss of potency from solutions in which absorbable gelatin sponges were suspended. The gelatin sponges did not significantly alter the inherent pH of the solutions.

Streptomycin was stable in the presence of either gelatin sponge or oxidized cellulose.

When powdered thrombin concentrate (bovine) was reconstituted with an aqueous solution of penicillin or streptomycin, all constituents were compatible as evidenced by no loss of enzymatic or antibiotic potency.

The possible combinations for studies of this type are numerous, particularly as concerns the use of the absorbable matrices with aqueous solutions of various substances. Some of these are being investigated. Preliminary data indicate that ascorbic acid, which has been reported to be of interest in wound healing, shows little deterioration in the presence of gelatin sponge or oxidized cellulose.

Convulsions Occurring under Anesthesia. Analysis of 6 Cases. H. T. Wikle and R. J. Ryan, in *Am. J. Surg.* 73:83, 1947.

Convulsions during anesthesia are rather uncommon but it is important for physicians to be on the alert to treat these convulsions, and to prevent their occurrence if possible. Convulsions during anesthesia were encountered six times in one year during which 2,142 anesthetics were administered on the surgical service of the Cumberland Hospital, Brooklyn, N. Y.

The etiology is extremely vague. The literature is replete with reports of possible causes, many of which contradict each other, thereby making the situation more confusing.

Despite lack of knowledge concerning the causative factors, strict attention should be given to the preoperative care of patients, particularly those who are acutely ill and toxic, in an effort to lessen the number of convulsions during anesthesia. The reported incidence of convulsions associated with spinal anesthesia is negligible compared to that with inhalation anesthetics. It is worth while to consider the use of spinal anesthesia in these toxic patients. The authors recommend the prompt use of thiopental sodium (Pentothal sodium, Abbott) as advocated by Lundy. Heretofore, the mortality in patients having convulsions during anesthesia was extremely high. With Pentothal sodium at hand, this figure should be lower. There was only one death among the 6 patients herein presented and this was attributable, not to the convulsion but to hepatorenal failure on the fifth postoperative day.—Mary Frances Poe, in International Abstracts of Surgery, *Surg., Gynec. & Obst.* 85:304 (August) 1947.

Treatment of Multiple Myeloma. I. Snapper, in *J.A.M.A.* 133:157, 1947.

A series of 15 patients with multiple myeloma received Stilbamidine combined with a diet low in animal protein, and Pentamidine (diamidine compounds). Good results, characterized by a notable influence on the pain, were obtained.

The dosage schedule of Stilbamidine, which was given either intravenously or intramuscularly, and of the Pentamidine, is well described. To avoid a fall in blood pressure, the author recommends the subcutaneous injection of 0.25 cc. of a 1 in 2,000 solution of epinephrine ten minutes before the injection of Stilbamadine; 1/150 to 1/200 of a grain of atropine sulfate is given to patients in whom sweating and dizziness are noticed. Dissociated anesthesia in the region of the trigeminal nerve is one late sign of intoxication.

The author gives a complete analysis of the results obtained and states that the disease is not cured, but is checked temporarily. Three case reports are presented.—Georges E. Cloutier, in International Abstracts of Surgery, *Surg., Gynec. & Obst.* 85:175 (August) 1947.

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